

**U.S. Army Medical Research Institute of Chemical Defense  
(USAMRICD)**

**FIELD MANAGEMENT  
OF CHEMICAL CASUALTIES  
HANDBOOK**



Chemical Casualty Care Division  
USAMRICD  
MCMR-UV-ZM  
3100 Ricketts Point Rd.  
Aberdeen Proving Ground, MD 21010-5400

**SECOND EDITION**  
*July 2000*

### *Disclaimer*

The purpose of this Handbook is to provide concise, supplemental reading material for attendees of the Field Management of Chemical Casualties Course.

Every effort has been made to make the information contained in this Handbook consistent with official policy and doctrine.

This Handbook, however, is not an official Department of the Army publication, nor is it official doctrine. It should not be construed as such unless it is supported by other documents.

## TABLE OF CONTENTS

<b>INTRODUCTION</b>	<b>1</b>
<b>NERVE AGENTS</b>	<b>2</b>
<b>VESICANTS</b>	<b>16</b>
<b>CYANIDE</b>	<b>23</b>
<b>CYANIDE</b>	<b>23</b>
<b>LUNG-DAMAGING AGENTS</b>	<b>26</b>
<b>BIOLOGICAL AGENTS</b>	<b>29</b>
<b>PATIENT DECONTAMINATION</b>	<b>48</b>
<b>APPENDICES</b>	<b>92</b>
<b>APPENDIX F</b>	<b>99</b>

# INTRODUCTION

With the end of the Soviet Union as a global superpower, the world as we knew it ended, and a long, drawn-out turning point in world history began. We first witnessed this moment in 1990 with the formal reunion of East and West Germany, through Operations Desert Shield and Desert Storm, Operations Restore Hope in Somalia, and the United States (U.S.) involvement in the Balkans Conflict. This historic shift will persist well into the next century.

The ability and will to wage war on a large scale have not diminished, only shifted to new players. Former Soviet subjects have taken new and unpredictable directions. Strident nationalism and long suppressed ethnic rivalries have emerged with vicious, bloody warfare the end result. The disarray and economic upheaval inside Russia have allowed the sale of Russian weaponry and technology to perpetuate.

The so-called third world nations have also taken advantage of the new world order to challenge what was once thought unchallengeable. Economic investment and economic power have given military muscle to nations who, even ten years ago, were struggling just to feed their people. In some cases, this newfound power has also taken on nationalistic fervor.

As a consequence of the unprecedented world challenges, the threat spectrum faced by the U.S. into the next century has broadened. It now includes formerly democratic governments, members of regional cooperation alliances, and terrorists of all persuasions. Let's narrow our gaze somewhat and look at examples of threats within the chemical and biological (C/B) threat spectrum.

## THE C/B THREAT SPECTRUM

The threat of C/B weapons' use against coalition forces in Operation Desert Storm must be seen not as a one-time occurrence, but the first of many C/B threats the U.S. military will face. Throughout the world, nations are still attempting to, or have in fact, produced C/B agents and means to employ them. This handbook will provide some answers and suggestions, but you, the medical NCO, must read and research to ensure that the mission of providing health service support to chemical casualties will be successful.

# NERVE AGENTS

## GA, GB, GD, GF, VX

### Summary

#### Signs and Symptoms:

##### **Vapor:**

***Small exposure***—small pupils, runny nose, mild difficulty breathing.

***Large exposure***—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions, small pupils.

##### **Liquid on skin:**

***Small to moderate amount***—localized sweating, nausea, vomiting, feeling of weakness.

***Large amount***—sudden loss of consciousness, convulsions, no breathing, flaccid paralysis, copious secretions.

**Detection:** M256A1; Chemical Agent Monitor (CAM); M8 paper; M9 paper; M8A1; Automatic Chemical Agent Alarm (ACAA); M22.

**Decontamination:** M291; hypochlorite; large amounts of water; M295.

**Immediate management:** administration of MARK I Kits (atropine and pralidoxime chloride); diazepam in addition if casualty is severe; ventilation and suction of airways for respiratory distress.

# NERVE AGENTS

Nerve agents are considered the primary agents of threat to the U.S. military because of their high toxicity and effectiveness through multiple routes of entry. They are absorbed through the eyes, respiratory tract, and skin.

## TOXICITY

The nerve agents are Tabun (GA), Sarin (GB), Soman (GD), GF, and VX. Tables I and II show the toxicities of the nerve agents by inhalation and skin exposure.

The Ct is the product of the concentration (C) of a vapor or aerosol to which one is exposed and the time (t) to which one is exposed to that concentration (C). The units are usually  $\text{mg}/\text{m}^3$  for C and minutes for t. One can be exposed to a Ct of  $100 \text{ mg-min}/\text{m}^3$  by staying in a concentration of  $10 \text{ mg}/\text{m}^3$  for 10 minutes ( $10 \times 10 = 100$ ),  $20 \text{ mg}/\text{m}^3$  for 5 minutes ( $20 \times 5 = 100$ ), or  $5 \text{ mg}/\text{m}^3$  for 20 minutes ( $5 \times 20 = 100$ ). The Ct that will cause a biological effect is constant over a range of C and t. Thus, if a Ct of  $100 \text{ mg-min}/\text{m}^3$  of nerve agent causes shortness of breath, it would be a result of any combination of C and t that produces a product of 100.

The  $\text{LCt}_{50}$  is the Ct of agent vapor that will be lethal (L) to half of the population exposed to it. The  $\text{ICt}_{50}$  is the Ct that will incapacitate (I) half of those exposed to it. The word “incapacitate” must be defined when using this term. For example, dim vision might incapacitate a soldier for some jobs, in which case the  $\text{ICt}_{50}$  will be the Ct needed to cause dim vision. On the other hand, incapacitation might be defined as loss of consciousness and twitching, in which case the  $\text{ICt}_{50}$  will be the Ct needed to produce these effects. The  $\text{ICt}_{50}$  shown is that causing severe effects, including convulsions.

Table I shows the estimated  $\text{LCt}_{50}$ , estimated  $\text{ICt}_{50}$ , and Ct that will cause pinpointing of the pupils (miosis) in half of the population ( $\text{MCt}_{50}$ ). Units of the Cts are  $\text{mg-min}/\text{m}^3$ . Table II shows the estimated amounts that will cause lethality in half of the population when placed on the skin.

The  $\text{LD}_{50}$  is the dose (D) of agent liquid or solid that is lethal (L) to half of the population exposed to it. The  $\text{LD}_{50}$  of VX, when placed on human skin, is the size of a droplet that will cover the width of two columns of the Lincoln Memorial on a Lincoln penny.

**TABLE I. Vapor Toxicity**  
*mg-min/m<sup>3</sup>*

<b>Agent</b>	<b>LC<sub>50</sub></b>	<b>IC<sub>50</sub></b>	<b>MC<sub>50</sub></b>
GA	400	300	2-3
GB	100	75	3.0
GD	70	UNK	<1.0
GF	UNK	UNK	<1.0
VX	50	35	0.04

**TABLE II. LD<sub>50</sub> on Skin**

<b>Agent</b>	<b>Amount</b>
GA	1000 mg
GB	1700 mg
GD	50 mg
GF	30 mg
VX	10 mg

## MECHANISM OF ACTION

When a soldier is poisoned by a nerve agent, the action of the enzyme acetylcholinesterase is blocked. The normal function of acetylcholinesterase is to break down or hydrolyze the chemical acetylcholine. Acetylcholine is a neurotransmitter, or messenger chemical. Nerve paths, which are divided into sections with gaps between the nerve endings and between the nerve ending and the target organ, are used to pass a command from the central nervous system to various organs. These gaps are crossed by acetylcholine, the messenger, which relays the command on to the next step and finally to the target. Under normal conditions, when the required action at each step is completed, the acetylcholine is broken down by the acetylcholinesterase, thus stopping the action. However, when a nerve agent inhibits the acetylcholinesterase, this enzyme cannot perform its normal function of hydrolyzing the acetylcholine. Acetylcholine then accumulates along the nerve path, and the target organ's action continues uncontrolled. Muscles become hyperactive and twitch uncontrollably, and glands secrete copiously.

## NERVE AGENT EFFECTS

The nerve agent's mechanism of action is to inhibit the enzyme acetylcholinesterase. Inhibition of this enzyme allows the neurotransmitter, acetylcholine, to accumulate at the nerve endings where it causes excessive stimulation of the target organ. The parts of the body that are affected by excessive acetylcholine accumulation are as follows:

- Eyes
- Nose (glands)
- Mouth (glands)
- Respiratory tract
- Gastrointestinal tract
- Cardiac muscle
- Sweat glands
- Skeletal muscle
- Central nervous system

The primary concern of the soldier medic/combat lifesaver when treating the nerve agent poisoned soldier is to provide correct, timely, and lifesaving care. The first step in providing this care is to understand the effects that a vapor or liquid nerve agent exposure has on the soldier.

**Eyes.** The eyes will be affected by direct contact with a nerve agent vapor or aerosol. When the route of entry of the agent is through the skin or by ingestion, the effect on the eyes is delayed or may not occur. The main effect of the agent is to cause miosis, or pinpointing, of the pupils. One or both pupils may be pinpointed and unresponsive to light or darkness. Pinpointing causes a complaint of dim vision that is more pronounced in low light conditions. Frontal headache, mild aching around the eye, or severe pains are common complaints in a soldier exposed to a moderate concentration of agent. Twitching of the eyelids may be observed through the protective mask, and the eyes may be reddened. When a light source is used to test for pupillary response, the soldier may complain of an increase in aching behind the eyes due to light sensitivity.

**Nose and Mouth.** The secretory glands of the nose and mouth are as sensitive or more sensitive to nerve agent vapor or aerosol than the eyes are. When the soldier is poisoned by nerve agent liquid on the skin or by ingestion, the nose will become affected, but only in response to the whole body (systemic) involvement. When exposed to a nerve agent vapor or aerosol, the nose will begin to run. This effect has been described by patients recovering from accidental nerve agent vapor exposure as “worse than a cold or hay fever” and “like a leaking faucet.” Even after low concentrations of agent, rhinorrhea may be severe.

The mouth will secrete excessive amounts of saliva that may be so copious that watery secretions run out the corners of the mouth.

**Respiratory Tract.** Inhalation of a small amount of nerve agent vapor will cause the soldier to complain of tightness in the chest or shortness of breath (dyspnea). This occurs because the excessive acetylcholine stimulates the muscles in the airways to contract and constrict the airways (bronchoconstriction). As the concentration increases, breathing difficulty will become severe. One or two breaths of a high concentration of nerve agent vapor will cause gasping and irregular respirations within seconds to a minute or two. Cessation of breathing (apnea) can occur within minutes after exposure to a large amount of nerve agent, either by liquid on the skin or vapor.

Excessive bronchial and upper airway secretions caused by stimulation of the airway glands by the excessive acetylcholine will compound breathing difficulty. These secretions can obstruct the airway and cause difficulty in moving air into and out of the lungs with prolonged expiration a noticeable effect.

**Gastrointestinal (GI) Tract.** After exposure to a large but sublethal concentration of vapor, the soldier will complain of nausea and may vomit. Also, nausea and vomiting may be the first effects from liquid nerve agent exposure on the skin. The soldier may complain of nausea followed by vomiting, "heartburn," and pain in his abdomen. In addition, the soldier may belch frequently and have diarrhea or involuntary defecation and urination. These effects usually occur within several minutes after vapor exposure. However, after liquid agent exposure on the skin, these effects may not begin for as long as 18 hours after exposure.

**Cardiac.** The heart rate can either increase or decrease after nerve agent exposure. Generally, blood pressure will increase, but the blood pressure can rarely be determined in a contaminated area because the casualty and the examiner are in protective gear. The heart rate in nerve agent poisoning will not aid the soldier medic/combat lifesaver in choosing the care needed.

**Sweat Glands.** The skin is very permeable to nerve agent. When penetration occurs after either liquid or vapor exposure, localized sweating occurs and progressively spreads over the surrounding skin area as nerve agent is absorbed. The likelihood that the soldier medic/combat lifesaver will be able to observe this sweating is minimal.

**Skeletal Muscles.** After exposure to a moderate or large amount of nerve agent, the soldier will complain of weakness and twitching of muscle groups. The twitching can first be noticed at the site of a liquid droplet on the skin. The muscles may show a rippling effect (fasciculations). As the nerve agent effect progresses, muscles can go into a prolonged contraction. However, instead of a prolonged contraction, the large muscle groups may begin unsynchronized contractions that cause the arms and legs to flail about. The hyperactivity of the muscles in these instances leads to muscle fatigue and flaccid paralysis (limp, unable to move). Unless the soldier medic/combat lifesaver aggressively cares for this casualty, he/she will not survive.

**Central Nervous System (CNS).** In the case of a large inhalation or liquid dose, the effects are rapid and usually fatal under battlefield conditions. The soldier almost immediately loses consciousness, followed seconds later by seizure activity. Several minutes later, respiration ceases. Without immediate care, this soldier will not survive to reach Level 1 treatment.

When exposed systemically to low amounts of nerve agent, the soldier may complain of generalized weakness.

Understanding when these effects can most occur is critical for the soldier medic/combat lifesaver. The length of time a casualty may be in your care is unknown. It is best to understand what may occur and when, because being surprised by and unprepared for the reactions of a nerve agent poisoned soldier lessens his chances for survival. Tables III and IV show nerve agent effects, the onset time of these effects, and the required self- and buddy-aid.

These tables show the typical time course for mild, moderate, and severe exposures to nerve agent. When a lethal or near lethal exposure occurs, the time to onset of symptoms and maximal severity of symptoms may be extremely brief. If aggressive care is not given to the soldier exposed to a lethal concentration, death can result within five minutes after the appearance of symptoms.

**TABLE III. Nerve Agent Effects**

***Vapor Exposure***

**Mild**

Eyes	Small pupils (miosis) Dim vision Headache
Nose	Runny nose (rhinorrhea)
Mouth	Salivation
Lungs	Tightness in the chest

Time of onset: seconds to minutes after exposure

**Self-aid:** 1 MARK I Kit

**Buddy-aid:** stand by

**Severe**

All of the above, plus  
Severe breathing difficulty or cessation of respiration  
Generalized muscular twitching, weakness, or paralysis  
Convulsions  
Loss of consciousness  
Loss of bladder, bowel control

Time of onset: seconds to minutes after exposure

**Self-aid:** none; soldier will be unable to help himself

**Buddy-aid:** three MARK I Kits and diazepam **immediately**

**TABLE IV. Liquid on Skin**

**Mild/Moderate**

Muscle twitching at site of exposure  
Sweating at site of exposure  
Nausea, vomiting  
Feeling of weakness

**Time of onset:** 10 minutes to 18 hours after exposure

**Self-aid:** 1-2 MARK I Kits, depending on severity of symptoms

**Buddy-aid:** stand by

## **Severe**

All of the above, plus  
Breathing difficulty or cessation of breathing  
Generalized muscular twitching, weakness, or paralysis  
Convulsions  
Loss of consciousness  
Loss of bladder and bowel control

**Time of onset:** minutes to an hour after exposure

**Self-aid:** none; soldier will be unable to help himself

**Buddy-aid:** three MARK I Kits and diazepam **immediately**

## **TREATMENT**

**The most important care the casualty receives is the care given within the first several minutes after exposure (self-aid, buddy-aid).**

Immediate care, including administration of antidotes, can mean the difference between survival and death in a soldier exposed to a nerve agent. It is imperative that every medic/combat lifesaver understand the effects of nerve agents, the time in which effects occur, and the correct steps to take to save the exposed soldier.

Every soldier must know the signs and symptoms of mild and severe nerve agent poisoning and the correct first aid in order to evaluate and provide the appropriate self- and buddy-aid.

## **SELF-AID AND BUDDY-AID**

Timely and correct determination of the type of agent and route of entry causing the signs or symptoms is critical if the poisoned soldier is to survive to reach definitive medical care. Nerve agents will, under most field conditions, be encountered in both the vapor and liquid forms. When nerve agents are encountered and soldiers have donned protective equipment, a hasty self-evaluation for signs or symptoms of poisoning must be conducted. This self-evaluation implies that soldiers know the signs and symptoms of mild and severe nerve agent poisoning, as well as the correct first aid.

Tables III and IV show methods of exposure, resulting signs or symptoms, and self-aid or buddy-aid to be rendered. It must be stressed that timely and correct first aid actions are critical to enhance the casualty's chances for survival.

It must be emphasized during training that, when the effects progress to more than one organ system, the situation is moving rapidly from a mild to a severe exposure. The buddy's aid in determining this change becomes critical. As the change occurs, the remaining MARK I Kits and one diazepam autoinjector must be administered.

Self- or buddy-aid must be promptly followed by Level 1 medical care.

## SOLDIER MEDIC/COMBAT LIFESAVER TREATMENT OF NERVE AGENT POISONING

The Level 1 care provider (medic) must rapidly determine the following:

- extent of the poisoning
- what medications have been administered
- complications induced by the poisoning and/or resulting from conventional wounds

## PROTECTIVE POSTURE DURING TREATMENT

First, protect yourself by donning MOPP Level IV.

## CASUALTY DECONTAMINATION

Next, assist the casualty in performing decontamination of exposed skin in the following order:

- face
- neck area
- chest area
- abdomen
- arms and hands
- other exposed skin areas

Performing this decontamination eliminates nerve agents on the skin surface that could continue to absorb into the skin causing a “time release” effect of symptoms.

## TREATMENT GUIDELINES

The treatment guidelines provided below assume that the soldier medic/combat lifesaver is certain that nerve agent poisoning has occurred. Use of atropine in the absence of nerve agent will cause the casualty to experience sweat inhibition and heat storage problems in a warm climate.

## DRUG THERAPY

**Atropine is the drug of choice for treating nerve agent poisoning.** It will **dry secretions**, (including those in the airways), **reduce bronchoconstriction**, and **decrease gastrointestinal motility**.

Atropine **will not relieve miosis** and **will not relieve muscle twitching or spasms**.

## **Mild and Improving Symptoms**

Observation is all that is needed for the casualty with mild symptoms such as rhinorrhea, slight or recovering breathing difficulty, or excessive salivation that is decreasing. In the casualty with mild symptoms that appear to be clearing, the one MARK I Kit administered during self-aid, followed by observation for several hours, will normally be all that is needed.

Pain in the eyes, twitching of the eyelids, redness, and miosis cannot be treated in the field setting by the soldier medic/combat lifesaver. However, at the battalion aid station (BAS), eye pain can be controlled with atropine eye drops. These conditions, although annoying, are not life threatening.

## **Severe Symptoms**

If the casualty has severe symptoms involving two or more major organ systems (systemic) (gastrointestinal, skeletal muscle, respiratory, etc.), the first step is to administer all three MARK I Kits and diazepam. **Diazepam should always be administered when the three MARK I Kits are given together.** Additionally, more atropine (2 mg, Atropen) should be given every five minutes until secretions decrease or the casualty is breathing easier (or it is easier to ventilate him). A total of 15 to 20 mg of atropine may be required in the first 3 hours after the onset of symptoms.

**Atropine.** If the casualty is unconscious and in respiratory difficulty, **three MARK I Kits and diazepam should be given immediately**, followed by additional atropine as described above. Over the next 5 to 15 minutes, 10 to 15 mg of atropine may be needed. Atropine administered with the autoinjector will show some effectiveness in three to five minutes. During the time the atropine takes to reach maximum effect, the constriction and secretions in the airway and feeling of “tightness in the chest” will begin to decrease. Atropine will have a drying effect on salivation and rhinorrhea. Atropine (2 mg) should be administered at three to five-minute intervals until the casualty can tell the soldier medic/combat lifesaver that it is easier to breathe or manual ventilation becomes easier. Observe the casualty for indications that the atropine can be discontinued.

Discontinue atropine when:

- Secretions of the mouth, nose, and lungs are minimized.
- The casualty tells you that breathing is easier, or it is easier to administer assisted ventilation.

**Pralidoxime Chloride** (2-PAMCl) in the autoinjector (600 mg, 2 ml) is the second drug for use in nerve agent poisoning cases. The 2-PAMCl removes nerve agent from

the enzyme acetylcholinesterase. The 2-PAMCI (included in the MARK I Kit) must be used as early as possible. If symptoms are severe, involving two or more organ systems (for example, the lungs and gastrointestinal tract), all three MARK I Kits **and diazepam** should be given immediately. Additional 2-PAMCI autoinjectors are not administered until an hour later. If severe signs or symptoms still persist one hour after using the three MARK I Kits, three additional 2-PAMCI autoinjectors should be administered. More than two sets of three 2-PAMCI (six total) must not be used. Excess 2-PAMCI may harm the casualty by dangerously raising the blood pressure.

Discontinue the use of 2-PAMCI after symptoms of respiratory distress have eased.

Diazepam in the 10-mg autoinjector is the drug adopted by the U.S. military for use in controlling convulsing patients. The doctrine for its use instructs the soldier to administer one diazepam autoinjector to his buddy immediately after using the third MARK I Kit in severe poisoning cases. **Diazepam is not for self-use.** It should be given only to severe casualties, and severe casualties cannot self-administer it. The key to increasing the effectiveness of the diazepam is administering it before convulsions begin. Again, when two or more organ systems become involved, one diazepam autoinjector should be administered along with the three MARK I Kits to lessen the convulsive activity the soldier may experience.

The soldier medic/combat lifesaver may administer a second and third diazepam autoinjector using the guidelines below.

After the first injection (buddy-aid):

- Observe the casualty for about ten minutes.
- Turn the casualty on his/her side to facilitate breathing.
- Pad areas to prevent other injuries.
- Restrain if necessary.
- If still convulsing after ten minutes, give the second diazepam autoinjector.

Following the second injection (medical aid):

- Observe the casualty for five to ten minutes.
- If still convulsing after five to ten minutes, give a third diazepam autoinjector.

## VENTILATION

Although the use of pyridostigmine pretreatment will decrease the need for assisted ventilation in nerve agent casualties, the need will arise, on occasion, for assisted ventilation in some severe nerve agent casualties. Aggressive airway maintenance and the use of assisted ventilation will greatly increase the casualty's chances for survival.

Providing assisted ventilation in a potentially contaminated environment is possible using the Resuscitation Device Individual Chemical (RDIC) (see chapter on equipment). By using this device, the soldier can survive to reach the Level 1 care facility where mechanical ventilation can take over. Without this aggressive, far-forward resuscitation, the soldier will not survive.

## PRETREATMENT

The U.S. military has adopted the policy of pretreating soldiers against the nerve agent's effect on acetylcholinesterase with pyridostigmine. Each soldier in the combat theater of operations is issued one package of pyridostigmine tablets. Each blister pack contains 21 tablets, and each tablet contains 30 mg of pyridostigmine. The soldier takes the pretreatment only **on order** from the unit commander. **When ordered**, one tablet is taken orally every eight hours. If a scheduled dose is missed, **it will not be made up**; the soldier will take one tablet at the earliest opportunity to begin the next eight-hour interval. The soldier will discontinue taking the tablets **on order** from the unit commander. The pretreatment should not be taken on a continuous basis for longer than 14 days.

Pyridostigmine bromide shields the acetylcholinesterase enzyme from the full effects of GD. It prevents GD from permanently and irreversibly binding the enzyme, which it would otherwise do in two minutes. Pyridostigmine enhances the efficacy of 2-PAMCl in GD casualties. The pretreatment does not increase the effectiveness of treatment for GB, GF, or VX. These nerve agents also become irreversibly bound to acetylcholinesterase but require many hours to do so, and the binding does not affect therapy.

Pretreatment alone will not protect the soldier and does not reduce the effects from the nerve agent. **Pretreatment is not an antidote.** When used in conjunction with the MARK I Kit, pyridostigmine enhances the effectiveness of the MARK I Kit against GD **only**. It is critical that the soldier medic understand that the effect of the pretreatment will have no effect on the severity of nerve agent poisoning symptoms. Therefore, an aggressive approach to care is still warranted.

## MUSTARD HD, L

### Summary

**Signs and Symptoms:** asymptomatic latent period (hours). Erythema and blisters on the **skin**; irritation, conjunctivitis and corneal opacity and damage in the **eyes**; mild upper **respiratory** signs to marked **airway** damage; also gastrointestinal effects and bone marrow stem cell suppression.

**Detection:** M256A1; CAM; M8 paper; M9 paper.

**Decontamination:** M291; M295; hypochlorite; water in large amounts.

**Management:** Decontamination immediately after exposure is the only way to prevent damage. Symptomatic management of lesions.

## VESICANTS

The blister agents are second only to nerve agents as a concern to the U.S. military. The primary threat blister agents are sulfur mustard (H/HD), Lewisite (L), and a mixture of mustard and Lewisite (HL).

Mustard is a concern because there are large stockpiles of it, it is easily manufactured, and because it is both incapacitating and lethal. Mustard was the largest cause of chemical casualties in World War I. It was also used extensively by Iraq in the war with Iran. Although there were many casualties from mustard in World War I, only about 3% of the casualties died as a result. This low death rate occurred despite the relatively poor protection and level of medical care available at that time (e.g., no antibiotics).

Mustard rapidly penetrates the skin causing both localized cellular damage and systemic damage. The true deadly nature of the agent's effect is that the soldier exposed to a large amount of liquid or vapor mustard faces total systemic assault. The reasons for this are (1) failure of the body's immune system, with sepsis and infection as the major contributing causes of death, and (2) pulmonary damage, which is also a major contributory factor in death.

### PHYSICAL CHARACTERISTICS

The severity of blister agent effects will, in part, be affected by the environmental conditions at the time of exposure. Warm, humid conditions increase the severity of blister agent damage and shorten the time of symptom onset. Cold weather retards the time of symptom onset, and providing the exposed skin remains cold, lessens the severity of blister agent damage.

Mustard (H/HD) has a fairly high freezing point of 58°F agent, while the mixture HL, containing 37% HD to 63% Lewisite, has a freezing point of -13°F. The lower freezing point of the mixture will cause the agents to have a significant impact on combat operations in a cold northern environment, as well as in a warm desert environment.

Blister agents also have a relatively high vapor density when compared to air. Mustard has a vapor density 5.4 times greater than air, Lewisite a density 7.1 times greater, and HL is 6.5 times heavier than air. The more dense a vapor is, the more likely it is to flow to low spots such as valleys, closed spaces, or the floor.

The soldier medic/combat lifesaver can use the current intelligence on threat chemical capabilities and the physical characteristics of blister agents to determine likely exposure mechanisms (liquid and/or vapor) based on temperature. Utilizing all of these data elements, the combat lifesaver and combat medic can then be proactive to the predicted chemical threat; that is, take active steps to prevent or lessen the impact of chemical agent employment on individuals. This information, coupled with understanding the medical implications of an exposure, will allow the combat

lifesaver/soldier medic to “wargame” scenarios and anticipate, ahead of time, the required, correct response needed to optimize casualty care.

When operating in cold northern climates or desert regions, particularly at night, care must be exercised to prevent getting contamination into warm-up tents, operations areas, or sleeping areas. An agent at its freezing temperature brought in on clothing or skin will liquefy as it warms and slowly produce vapors. Unless this situation is detected early, soldiers will be exposed within these confined spaces. In the temperature ranges mentioned earlier, provisions must be made for monitoring personnel and their equipment in a warm-up tent before the individuals occupy work or rest areas. All personnel in the monitoring tent must wear protective masks during monitoring.

If the unit fails to conduct monitoring of personnel and equipment before entering sleep or work areas, the potential exists for intoxication by multiple routes of exposure. Soldiers could absorb agent through the skin by handling equipment contaminated with a liquid agent, or vapors desorbing from equipment contaminated by liquid agent could affect the eyes and respiratory tract.

## DETECTION

Mustard received its name because of its garlic, horseradish, or mustard odor and can be detected by smell, visual observation, M8 and M9 Chemical Detection Papers, the M256A1 Chemical Detection Kit, and the CAM.

The human nose can detect mustard (H/HD) in concentrations of 0.6 to 1.0 mg/m<sup>3</sup>. While this seems an undesirable way to detect blister agent, it must be understood that the U.S. military has no automatic vapor/liquid detection capability. Alert soldiers will most likely smell the agent vapor before encountering the liquid.

After release, H/HD appears as a thick, colorless or pale yellow liquid, and HL appears as a dark oily liquid.

The M8 Chemical Detection Paper will turn red in the presence of liquid mustard. The detector ticket from the M256A1 will detect mustard vapor in concentrations of 2 mg/m<sup>3</sup> to 12 mg/m<sup>3</sup> within 10 minutes. The CAM will detect mustard in concentrations of 0.03 mg/m<sup>3</sup> to 30 mg/m<sup>3</sup>.

## EFFECTS

**H/HD.** Clinical signs and symptoms from mustard exposure are not apparent until hours later (see Table); however, tissue damage occurs within two minutes. If decontamination is not done within the first two minutes after exposure, nothing can be done to prevent a mustard injury.

Clinical effects occur on the skin, in the eyes, and in the airways. In the event of severe exposure, effects occur days later in the bone marrow and gastrointestinal tract.

The effects on the skin are redness (erythema) that resembles sunburn, and later, blisters. The eyes initially are irritated and later may become swollen shut. The first effects in the airways are the upper airways, with a hacking cough, hoarseness, and throat and nasal irritation. If the exposure is severe, the agent later damages the lower airways.

The major effects and the times at which the first effects begin are shown in the table.

**HL.** The effect of HL liquid on the eyes and skin, or vapor in the eyes or respiratory tract, is immediate. HL causes intense pain and lid twitching in the eyes. Within an hour, edema of the conjunctivae and lids begins and rapidly results in eye closure.

The casualty feels stinging pain within seconds after contact with liquid HL. The pain causes the casualty to decontaminate rapidly. **Rapid decontamination is the only way to avoid severe burns.** After five minutes of contact with HL, the upper layer of skin (epithelium) will die and appear gray. Painful erythema will begin shortly afterwards, and painful blisters may appear within 12 hours.

The immediate irritation from HL vapor is so intense that an individual will immediately mask or exit the area. Respiratory casualties will be unable to do either. Pulmonary effects are similar to those caused by mustard alone, except that pulmonary edema (fluid in the lungs) is more likely after Lewisite.

## SELF-AID AND BUDDY-AID

The actions needed for self-aid or buddy-aid are essentially nonmedical in nature. Reacting as quickly as possible to warnings of an attack by donning the protective mask and going to MOPP IV, detecting the agent as early as possible, and removing any suspect liquid (decontaminating) using the M291 Skin Decontaminating Kit (SDK) are the easiest ways to prevent a blister agent casualty. Reacting quickly to attack indicators will prevent most, if not all, casualty-causing exposures. Some indicators that an attack is in progress or you have come in contact with agent from a previously unknown attack are as follows:

- The out of place smell of mustard, garlic, or onion.
- Color change in M9 detector tape.
- Overt indications such as enemy helicopters spraying liquid, indirect artillery fire which detonates with dull or muffled explosions.
- An oily feeling of “rain” as it impacts on exposed skin.
- Liquids that appear too thick or oily and appear out of place on equipment, plants, or terrain.

Self-aid or buddy-aid for exposure to blister agents includes decontamination of the eyes. When exposure is suspected, time is critical. Unless the individual was wearing a protective mask at the time of the suspected exposure, the assumption must be that the eyes were exposed. Following the task in STP 21-1-SMCT, Soldier's Manual of Common Tasks, the individual must decontaminate the eyes and, although this is not a buddy-aid task, having assistance will increase the effectiveness of the procedure.

**Remember that time is critical for effective mustard decontamination because blister agents become “fixed” to tissue components within two minutes after deposition.** Using the M291 SDK as soon as possible to remove agent and flushing the eyes with water will do much to prevent or lessen the physical damage from blister agent exposure.

**TABLE. Effects of Mustard Vapor**

<b>ORGAN</b>	<b>SEVERITY</b>	<b>EFFECTS</b>	<b>ONSET</b>
Eye	Mild	Tearing Itchy Burning Gritty feeling	4-12 hours
	Moderate	Above, plus Reddening Swelling of lids Moderate pain	3-6 hours
	Severe	Marked swelling of lids Possible cornea damage Severe pain	1-2 hours
Airways	Mild	Runny nose Sneezing Nosebleed Hoarseness Hacking cough	12-24 hours
	Severe	Above, plus Severe productive cough Shortness of breath (mild to severe)	2-4 hours
Skin		Erythema (redness) Blisters	2-24 hours

## **COMBAT LIFESAVER/MEDIC ACTIONS**

The initial medical treatment actions required by the combat lifesaver/soldier medic at the time of exposure is little more than what the individual himself can do. Self-aid decontamination must be done at the time of exposure. Because of the long time delay until the onset of symptoms under combat conditions, the wounded, exposed individual will have been returned to duty or evacuated by the time symptoms appear.

## CASUALTY DECONTAMINATION

The casualty should have performed skin and equipment decontamination with the M291 and the M295 before being seen by the combat lifesaver/soldier medic. Because of the persistent nature of blister agents, the decontamination of the patient must be as thorough as possible. As with nerve agent exposure, you must protect yourself by masking and donning MOPP gear. When beginning treatment, attempt to determine what type of decontamination has been done and when. Understanding the potential contamination threat posed by the casualty will allow the combat lifesaver/soldier medic to avoid cross contamination.

## FIELD TREATMENT

The actions required at the unit level for blister agent casualties are two-fold. First is triage for evacuation or return to duty, and second is the actual treatment of the casualty. Triage of the soldier is based on several factors – the severity of observable effects, the opinion of the triaging combat lifesaver/soldier medic as to whether or not the effects will progress further, and the impairment of normal duty requirements the symptoms cause in the individual.

Casualties with signs or symptoms that appear at the earliest onset time possible (see Table) generally require evacuation with little chance for quick return to duty from the Medical Treatment Facility (MTF) because the initial effects will progress. Faster onset of symptoms can indicate exposure to higher concentrations of agent with more severe lesions, for which the care available at a MTF is required.

**Eyes.** Individuals with mustard conjunctivitis will require application of a steroid antibiotic eye ointment. FM 8-285, Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries, recommends dexamethasone sodium phosphate-neomycin ophthalmic ointment for application. This drug decreases the inflammation and has antibacterial effects. Systemic narcotic analgesics are recommended for eye pain. Under no circumstances should the eyes be bandaged as this will allow the eyelids to stick together, and the secretions will not have a means to drain. The resulting accumulation in the conjunctival sac can lead to infection and corneal ulcerations. Individuals presenting with blister agent conjunctivitis will require evacuation to a MTF for treatment by an ophthalmologist as soon as possible.

**Skin.** Individuals presenting with erythema (reddening of the skin) which limits motion in a limb will need to be evacuated. Erythema covering greater than 5% of the body in noncritical areas, using the Rule of 9s to determine the coverage, will require evacuation. Individuals with erythema involving less than 5% of the body may need evacuation, but this usually is determined by the location of the erythema and the duty impairment caused. The treatment for erythema is that needed for the itching and burning sensations that accompany it. Application of a topical

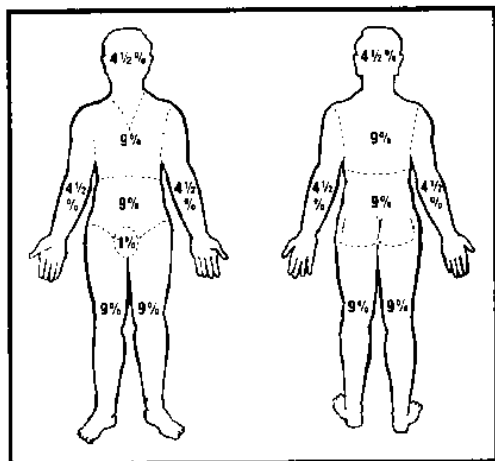
steroidal cream or calamine lotion will provide temporary relief.

Normally erythema progresses to vesication (blister formation) with the size and number of blisters forming being dependent on the severity of exposure, skin condition (sweaty and moist or dry) at the time of exposure, and location of the exposure on the individual. Blisters the size of a quarter or smaller or should be left intact, if possible. The blister, which is filled with a sterile fluid, will act as a protective cover over the wound providing good protection from infection. These small, unbroken blisters should be covered with a petrolatum gauze bandage. The dressing should be changed every three to four days. The blister fluid does not contain live agent.

Large blisters should be deroofed, and blisters that have broken should have the ragged roof of the blister removed. The area of the open blister should be cleaned with tap water or saline and a petrolatum gauze bandage applied. The primary concern when treating blisters of any size is prevention of infection. The decision to evacuate or return to duty must not be made only on the basis of blister formation. Initial blister formation may be slight, but over time could progress to large blisters unmanageable in the field. If a casualty is not evacuated, the combat lifesaver or soldier medic must instruct the individual on self-aid care for the blister. The individual should be given a topical antibacterial cream such as 10% mafenide acetate or silver sulfadiazine burn cream and instructed to apply a 1/8 inch layer to the blister four times a day. The area should then be covered by a petrolatum gauze bandage.

**Lungs.** The soldier who presents with any sign or symptom of respiratory exposure should be evacuated promptly. The combat lifesaver/soldier medic cannot determine damage to the larynx or trachea. Any unnecessary delay in diagnosis and required treatment at the MTF must be avoided.

**FIGURE**



**Estimation of body surface area by the use of the Rule of 9s. (Copied from FM 8-230)**

## CYANIDE AC, CK

### Summary

**Signs and symptoms:** few. After exposure to high Ct, seizures, respiratory and cardiac arrest.

**Detection:** M256A1 Kit Detector Sampler; **NOT** the M8A1 alarm and CAM.

**Decontamination:** Skin decontamination is usually not necessary because the agents evaporate rapidly. Wet, contaminated clothing should be removed and the underlying skin decontaminated with water or other standard decontaminants.

**Management:** **Antidote:** intravenous nitrite and sodium thiosulfate.

**Supportive:** oxygen; correct acidosis.

## CYANIDE (CYANOGENS; BLOOD AGENTS)

The two agents of most concern in the category commonly known as blood agents are hydrogen cyanide (AC) and cyanogen chloride (CK). The basic physical action of these agents is to disrupt oxygen utilization at the cellular level.

### PHYSICAL CHARACTERISTICS

These agents have a very high vapor pressure, which causes rapid evaporation of the liquid immediately after release. The rapid vaporization significantly reduces the likelihood of a liquid exposure. The AC or CK vapor initially on the ground will quickly expand outward and up. The high volatility will, within a very short time, cause the vapor to lose its lethal concentration near the point of delivery. Within a short period of time, it will pose little threat downwind from the release point. It is because of this quick dissipation of the vapor that these agents are called nonpersistent.

## DETECTION

The only detection available to the soldier is the M256A1 Chemical Detection Kit Detector Sampler. The first indication of contact with the agent AC might be the smell of bitter almonds, or in the case of agent CK, the sudden irritation of the nose and throat.

## EFFECTS

Cyanide causes very few signs and symptoms in man. Death occurs within minutes after inhalation of a large amount. Inhalation of a lower concentration will produce a slower onset of effects. The major signs and symptoms are shown in the table below.

**TABLE. Cyanide (AC and CK)**  
***Effects from Vapor Exposure***

**Moderate**, from low concentration

- Transient increase in rate and depth of breathing
- Dizziness
- Nausea, vomiting
- Headache
- Eye irritation

These may progress to severe effects if exposure continues. The time of onset of these effects depends on the concentration, but is often within minutes after exposure.

**Severe**, from high concentration

- Transient increase in rate and depth of breathing -- 15 seconds.
- Convulsions -- 30 seconds
- Cessation of respiration -- 2 to 4 minutes
- Cessation of heartbeat -- 4 to 8 minutes

In addition to the above, CK causes intense irritation of the eyes, nose, and airways.

## SELF-AID AND BUDDY-AID

The only self-aid for AC and CK is to mask. The only buddy-aid for AC or CK exposure may involve helping a soldier mask.

## COMBAT LIFESAVER/MEDIC ACTIONS

The rapid onset of symptoms may preclude the combat lifesaver/soldier medic from rendering aid. The symptoms shown in the table may occur within moments and lead rapidly to death.

Rapid evacuation to Level 1 medical care and administration of the cyanide treatment set will improve the casualty's chances for survival.

If the casualty can still talk and walk without difficulty after exposure and presents at the battalion aid station (BAS), he will survive.

## LUNG-DAMAGING AGENTS

Lung-damaging agents are not commonly mentioned as major chemical threats. Phosgene, a lung-damaging agent, was a major threat in World War I until mustard was introduced. Phosgene and similar agents have not been used on the battlefield since, primarily because other agents are more effective.

Although they are not considered threat agents, the military medic/combat lifesaver should know something about lung-damaging agents because the soldier might become exposed even though the enemy does not use the agents. Lung-damaging agents are hazards of the battlefield for other reasons. The primary lung-damaging agents and their possible sources are as follows:

**Phosgene.** As stated earlier, phosgene was a major threat agent in World War I until mustard was introduced. Today it is an industrial hazard in many manufacturing processes. More importantly, it is released from heating or burning many common chemicals or solvents. Carbon tetrachloride, perchloroethylene (a degreasing compound), methylene chloride (used in paint removal), and many other compounds break down to phosgene with flame or heat. Also, common substances such as foam plastics release phosgene when they burn. A soldier presenting with shortness of breath in the absence of a chemical attack or other obvious cause should be questioned very carefully about whether he has been near any burning substances or chemical vapors that were near flame or other hot materials (e.g., a heater with open coils).

**Perfluoroisobutylene (PFIB).** PFIB is given off when Teflon® burns. Although we know that Teflon® is used in many cooking devices, it is less commonly known that it lines the interior of many military vehicles, particularly armored vehicles. Fires in these vehicles release PFIB. Survivors of vehicle fires who are short of breath should be questioned carefully regarding their exposure to the smoke.

**Oxides of Nitrogen.** Oxides of nitrogen, or NO<sub>x</sub>, are products of burning gunpowder. These substances can build up to high concentrations with repetitive firing of large artillery. Soldiers who become short of breath after heavy firing should be suspected of exposure to this lung-damaging agent.

**HC Smoke.** HC smoke is used in training and for obscuration. It contains two components, including zinc, which can cause lung damage if inhaled in toxic amounts. Appropriate precautions must be taken when HC smoke is used.

## DETECTION

Phosgene smells like newly cut grass or freshly cut hay, but odor is not a reliable detection method. There are no field detection devices for these compounds.

## PHYSICAL PROPERTIES

Phosgene is very volatile. Under temperate conditions, it evaporates very quickly. Liquid phosgene may get on clothing and continue to release vapor. Although skin decontamination after vapor exposure is not a high priority, clothing should be removed and the underlying skin decontaminated with soap and water.

## MECHANISM OF ACTION

Phosgene is the most studied compound in this category. Less is known about the other compounds; however, it is believed that they are very similar.

Phosgene causes effects in the lung by inhalation only. It does not cause lung effects when absorbed through the skin, injected, or orally ingested.

When inhaled, phosgene travels to the very end of the smallest airways, the bronchioles, and causes damage to these airways. Additionally, it causes damage to the thin membrane that separates the smallest blood vessels (the capillaries) and the air sacs (the alveoli). Phosgene reacts with the proteins and enzymes in these alveolar-capillary membranes to cause damage to the membranes. These membranes usually function to separate the blood the capillaries from the air in the alveoli, but when the membranes are damaged, they cannot do this. Blood, or at least the liquid part of the blood, the plasma, can leak through the damaged membrane into the alveoli. When the plasma leaks into the alveoli, the air sacs become full of fluid, and air cannot enter them. Therefore, exchange of oxygen from the air into the blood is hindered, and the casualty suffers oxygen deprivation. The extent of the lack of oxygen depends on the extent of the phosgene exposure and the number of alveoli filled with plasma. This is similar to what happens with drowning, in that the alveoli fill up with fluid. However, in this instance, it is fluid from the blood, not from an external source. For this reason, phosgene poisoning is sometimes referred to as “dry land drowning.”

Although the mechanism may not be exactly identical, the other compounds in this category cause very similar effects by a similar mechanism.

## CLINICAL EFFECTS

Very shortly after exposure to phosgene, the casualty may notice irritation of the eyes, nose, and throat. More commonly, there may be no effects during or immediately after exposure. The **major effects** from phosgene (and the other compounds), like the effects from mustard, **do not occur until hours later**.

The casualty will notice shortness of breath between 2 and 24 hours after exposure. Initially, this may be mild, and the eventual severity of the shortness of breath (dyspnea) will depend on the amount of exposure. As the damage progresses, the dyspnea will become more severe, and soon a cough will develop. If the damage is severe, the

casualty will start coughing up a clear, foamy sputum, the plasma from his blood that has leaked into his alveoli.

A casualty with a very mild exposure to phosgene (or another of these compounds) will develop dyspnea 6 to 24 hours after exposure. He will notice it first after heavy exertion; however, later he will become short of breath after any activity. With proper care, he will do well and recover completely.

A casualty with a severe exposure to phosgene (or another of these compounds) will notice shortness of breath within several hours after exposure. Within four to six hours after exposure, he will find it increasingly difficult to breathe, even at rest. He may not do well, even with intensive pulmonary care.

The average casualty from a lung-damaging agent will be in between these two extreme cases. He will have the onset of dyspnea within six to eight hours after exposure and may progress to have dyspnea while at rest. However, with good pulmonary care beginning early after the onset of effects, he will recover completely.

## FIELD CARE

The medic/lifesaver should be alert to the possibility of exposure to a lung-damaging agent even when chemical agents are not being used. According to present threat estimates, exposure will be unlikely from the enemy. However, as noted above, exposure is likely from common military operations.

A casualty who complains of shortness of breath should be questioned extensively about exposure to smoke from burning Teflon®, gunpowder, or other chemicals.

The most important things to do for such a casualty are to ensure he is free from contamination (he is out of the smoke or wearing his mask) and is **kept completely at rest**. Complete rest is extremely important. There were instances in World War I in which phosgene casualties who were breathing comfortably at rest collapsed and died after walking a few yards. Even a little exertion can greatly intensify the effects of these agents. A casualty who is short of breath requires assisted ventilation with oxygen, or oxygen alone.

A dyspneic casualty must be evacuated as quickly as possible to a medical facility that can provide intensive pulmonary care. A casualty who becomes dyspneic within the first few hours after exposure will probably not survive, even with intensive care.

## BIOLOGICAL AGENTS

The potential use of biological agents on the future battlefield is based on numerous historical precedents. The earliest documented use of a biological agent was in the 6th century B.C. by the Assyrians. The Assyrians poisoned enemy water wells with rye ergot to induce severe gastrointestinal effects. The Black Plague that decimated Europe during the Middle Ages may have begun when the survivors of the siege of Kaffa returned to Europe. During the siege of Kaffa, the besieging Tartar army experienced an outbreak of bubonic plague, and in an effort to induce the surrender of Kaffa, hurled corpses of the bubonic plague victims into the city. This tactic resulted in the surrender of Kaffa and the introduction of the Bubonic Plague, which infected a portion of the defenders.

The use of smallpox as a weapon has been well documented. The British army used smallpox against the Native Americans who were loyal to the French during the French and Indian War with devastating results. The American army, during the subjugation of the Native Americans of Great Plains, used smallpox infected blankets in the same way the British had and with similarly devastating results.

The end of World War II brought the revelation of the intensive research effort by the Imperial Japanese army into the effective means of biological agent production, the medical effects of biological agent exposure, and the best method for delivering these agents to a target.

The most recent indication of offensive biological warfare capability came from Team 7 of the United Nations Special Commission who conducted inspections of Iraqi biological warfare research and development. The Iraqi government announced that prior to Operation Desert Storm, research had been conducted into the use of *Bacillus anthracis* (anthrax), botulinum toxins, and *Clostridium perfringens*. Thus, had the air war not been so effective, Coalition ground forces may have faced biological warfare agents.

## CLASSIFICATION OF BIOLOGICAL AGENTS

The U.S. classifies biological agents into three general categories – pathogens, toxins, or other agents of biological origin.

- Pathogens are disease-producing microorganisms such as bacteria, mycoplasma, rickettsia, fungi, or viruses. These microorganisms may be naturally occurring or “engineered” by manipulation of recombinant deoxyribonucleic acid (DNA).

- Toxins are poisons naturally produced through the activities of living organisms. Toxins can be produced by plants, microorganisms, and animals. Due to the feasibility of using some form of biochemical engineering to produce toxins, the U.S. has also

classified toxins as a biological agent. Examples of these naturally occurring organic chemical compounds are proteins, polypeptides, and alkaloids.

- Other agents of biological origin are a class of biological agent that can be found in the human body in very small quantities, but if introduced in large quantities, causes severe adverse effects or death. The most notable examples of this class are the bioregulators/modulators (BRM). The BRMs can be small molecules of peptides that act as neurotransmitters and/or modifiers of neural responses.

## CHARACTERISTICS OF BIOLOGICAL AGENTS

The qualities that are most advantageous to have in a biological agent and in the target population are high infectivity or toxic properties, desired contagiousness, severity of effects, short incubation period, and susceptibility of target population. The identification of biological attack and identification of a specific agent present serious problems in a tactical situation.

- High infectivity or toxic properties. A highly desirable characteristic would be the ability of the agent to produce an effect with the smallest number of organisms or the least amount of agent (e.g., toxins in gram weights) possible.

- Desired contagiousness. Being able to predict the agent's effect on the target population, the spread of the agent out of the target area, and the length of the agent's ability to cause the desired effect are all critical criteria of a biological agent. Although the ability of an agent to cause contagious transmission between humans has been seen as an undesirable trait, the use of these types of agents in "ethnic cleansing" style operations cannot be dismissed.

- Severity of effects. The use of a biological agent may be contemplated to cause only incapacitating effects in the target populations, or devastating lethal effects may be desired. The predictability of the end result of a biological agent release is critical.

- Susceptibility of target population. The introduction of any biological organism into a population that has little or no resistance or has not been immunized will wreak havoc, even if the selected agent causes only incapacitating effects.

## TACTICAL AND MEDICAL IMPLICATIONS OF BIOLOGICAL WARFARE

The tactical and medical impact of biological weapons employment can be minimized if medical personnel are familiar with the operational aspects of biological agent exposure. The operational aspects are listed below.

- Potential methods of dissemination
- Routes of entry
- Protection
- Decontamination
- Detection

The medical aspects of biological agent exposure are as follows:

- Potential biological agents
- Symptoms of exposure
- Transmission of infectious agent
- Incubation period of infectious agent
- Treatment of disease
- Vaccination

## OPERATIONAL ASPECTS OF BIOLOGICAL WARFARE

**Potential methods of dissemination.** The ability to produce biological agents and the means of employment are feasible with minimal resources. The traditional methods of dissemination are by aerosol, large liquid drops, dry powders, and arthropod vectors. Employment of one or more of these methods is not beyond the capability of most moderately industrialized nations. Also, dissemination by covert means, whether in a tactical environment or by terrorists, must also be considered.

- Aerosol dissemination. A live microorganism cultured in a moist environment can be introduced into the air in a wet aerosol. The use of an aerosol is considered more likely than any of the remaining methods.

- Large liquid drops (cutaneous). Using large liquid drops of agent, usually toxins will cause ground contamination similar to that of a persistent chemical agent.

- Dry powder. By employing a process similar to freeze drying, microbiological materials can be stored as a dry powder. This dry powder state causes a drastic increase in the stability of the agent in the open environment and makes dissemination much easier. In addition to dry powder, a pathogen can be protected by micro-encapsulation, and its use would be similar to a dry powder.

- Arthropod vector. This method of dissemination is the least likely to be used because of the cost of producing the vectors, controlling the vectors after their release, and natural predators that might destroy them. However, a vector might be able to circumvent protective clothing and mask.

- Covert. The use of a biological agent by a terrorist group is a potential threat. Any of these dissemination methods might be used against large population centers or military or political targets.

**Routes of entry.** Generally speaking, certain methods of dissemination are designed to achieve a desired effect through one primary route of entry. Effects that are achieved as a result of a secondary route of entry are considered a bonus. The physical form in which the biological agent is disseminated can be generally associated with a particular route of entry.

- Respiratory. Live microorganisms that remain suspended in the air in a wet aerosol pose an extremely effective method of introducing a disease into the target organism through the respiratory tract. Biological agents in a dry powder and microencapsulated can also be used to infect the target organism or population through a respiratory means.

- **Cutaneous.** The use of large liquid drops could deny terrain and cause secondary effects in humans who enter the area unaware of the threat through cutaneous means or by ingestion. Biological agents in a dry powder state and micro-encapsulated can also be used to infect the target population through a cutaneous means.

- **Ingestion.** The introduction of a biological agent into a drinking water supply or food production facilities could have a significant impact on a target population. The use of a dry powder or micro-encapsulated pathogen against a target population, although employed primarily for respiratory effects, has the additional bonus effect of infecting the target organism by being swallowed or introduced through touch.

**Protection.** The topic of protection is fairly simple when limited to the physical protection afforded by the Battle Dress Overgarment (BDO), chemical protective boots and gloves, and M40 series of protective masks. When fully encapsulated at MOPP IV, the soldier has complete respiratory and physical protection against all known biological agents.

The first action that all soldiers can take to better protect themselves from a biological agent is to understand and maintain good personal health while in garrison and in the field. At a minimum, this should include maintaining good physical fitness and proper weight, keeping immunizations up to date, practicing good personal hygiene, following field sanitation guidelines, and training on individual and collective nuclear/biological/chemical (NBC) defense tasks.

Prior to deployment, medical, chemical, and command staffs must completely understand the threat's ability in order to conduct biological warfare operations.

**Detection.** The U.S. Army has not fielded equipment capable of detecting and identifying biological agents; we have no remote biological agent detection capability. This lack of equipment increases the soldier's need to be aware of certain indicators (listed below) that suggest an attack is occurring or has already taken place.

- Mist or fog sprayed by slow moving aircraft or helicopter.
- Aerial bombs that pop, rather than explode.
- Artillery shells that detonate with less powerful explosions than HE rounds.
- Mysterious illness in both the soldier and civilian population that approaches epidemic numbers.
- Large numbers of dead wild and domestic animals.
- Unusual concentrations of insects or sighting of insects not normally found in the geographical region.

Some of these indicators are the same as those that could be found after a chemical attack, but with one critical difference. After taking immediate action to protect themselves, soldiers will be unable to detect and identify chemical agents vapors or

liquids. In the absence of reactions, a NBC-4 (Biological) report must be sent to higher headquarters.

**Decontamination.** Biological agents pose a contact hazard to soldiers by direct deposit on the skin and by indirect transfer from a contaminated surface to the soldier's skin, mouth, nose, or respiratory tract. When the soldier suspects that he has come in contact with contamination from a biological attack, he must decontaminate immediately.

Decontamination of exposed skin can be accomplished with the M291 SDK. When biological contamination is suspected, a 0.5% chlorine solution or warm soapy water can be used to remove the suspected agent from the skin.

Performing operator spray-down with the M11 or M13 portable decon apparatus and hasty decontamination with power-driven decontamination apparatus will flush biological agents from the surface of equipment and lower the direct and indirect transfer hazard.

The critical point to understand about biological agent contamination is not that the decontamination process destroys the agent, but that it is physically removed from the skin or equipment. Removal of the agent significantly decreases the hazard to the soldier.

## MEDICAL ASPECTS OF BIOLOGICAL AGENT EXPOSURE

**Potential biological agents.** The biological agents discussed in this section are listed below. These agents can be disseminated as an aerosol to specifically induce an effective dose via the respiratory tract.

- Smallpox
- Tularemia
- Cholera
- Bubonic Plague
- Anthrax
- Botulism
- Staphylococcal Enterotoxin B (SEB)
- Toxins

The following topics will be covered for each potential biological agent:

- Symptoms of exposure
- Transmission of infectious agent
- Incubation period of infectious agent
- Treatment of disease
- Vaccination

**NOTE:** Page numbers in the following text refer to FM 8-33, Control of Communicable Diseases in Man, 16th Edition, The American Public Health Association, Washington, D.C., 1995.

### **Smallpox**

This systemic viral disease was declared globally eradicated in 1979 by the World Health Organization. The only known samples of the disease-causing Variola Virus are in the “hot” labs at the Centers for Disease Control (CDC) in Atlanta, GA, and in the CDC’s Russian counterpart in Moscow. Vaccines are stockpiled. (page 425)

**Symptoms of exposure** are sudden onset of fever, headache, severe backache, malaise, rigors, and occasionally, abdominal pain. After two to three days, temperature falls and a rash appears. The rash develops into macules, papules, vesicles, pustules, and finally, scabs. The casualty is infectious during the entire term of the disease, which is usually three to four weeks. The first work is the worst.

**Transmission of infectious agent.** Transmission of the disease is by respiratory discharge, bed linens, the patient’s clothing, or skin contact with the scabs. Complete sterile handling should be enforced with complete quarantine for up to four weeks after the rash appears.

**Incubation period of infectious agent** averages from 7 to 12 days, with 10 to 12 days before onset of illness, and 2 to 4 days more to onset of rash.

**Treatment of disease:** none, other than supportive care.

### **Tularemia**

Tularemia is a zoonotic, bacterial disease with a variety of clinical manifestations related to route of introduction and the virulence of the disease agent. Stockpiles of vaccines for large usage do not exist. The only vaccine presently available is at the U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD. (page 501)

**Symptoms of exposure.** Usually presents as an indolent ulcer at the site of introduction of the organism with swelling of the regional lymph nodes. There may be only one or more enlarged and painful lymph nodes that may rupture and leak. Ingestion of organisms may produce a painful pharyngitis, abdominal pain, diarrhea, and vomiting. Inhalation of organisms may cause a pneumonia-like illness or systemic, febrile, septicemic syndrome. All forms may be complicated by pneumonia.

**Transmission of infectious agent.** The bacteria which causes Tularemia naturally infects numerous wild animals, especially rabbits, hares, muskrats, beavers, and some

hard ticks. It is transmitted to man through the bite of arthropod vectors, though ingesting or handling contaminated water and flesh, or by inhaling contaminated dust.

**Incubation period of infectious agent** ranges from 1 to 14 days, usually 3 to 5 days.

**Treatment of disease.** Streptomycin or gentamycin given for 7 to 14 days are the drugs of choice; the tetracyclines and chloramphenicol are bacteriostatic and effective when continued for no less than 14 days. Aspiration, incision and drainage, or biopsy of an inflamed lymph node can spread the infection and must be covered with prompt and specific antibiotics.

### **Cholera**

Cholera is an acute, bacterial enteric disease. Vaccines of moderate, short-term effect (three to six months) are stockpiled. (page 97)

**Symptoms of exposure** are sudden onset of profuse, painless, watery stools, occasional vomiting, rapid dehydration, acidosis, and circulatory collapse.

**Transmission of infectious agent.** The primary sources are water-borne contamination, fecal matter, or the ingestion of contaminated foods.

**Incubation period of infectious agent** is a few hours to five days; usually two to three days.

**Treatment of disease.** Prompt fluid therapy with volumes of electrolyte solution adequate to correct dehydration, acidosis, and hypokalemia is the keystone of cholera treatment. Mild to moderate dehydration should be treated with oral rehydration solutions; severe dehydration should be treated with IV. Tetracycline or TMP-SMX shortens the duration of diarrhea and reduces the volume of fluid lost.

## **Plague**

Plague is a specific zoonosis involving rodents and their fleas, which transfer the bacterial infection to people. Vaccination is protective against the bubonic form of the disease, but not against the primary respiratory form. (page 355)

**Symptoms of exposure.** Initial signs and symptoms may be nonspecific with fever, chills, malaise, myalgia, nausea, prostration, sore throat, and headache. Commonly a lymphadenitis develops in those lymph nodes receiving draining from the site of the fleabite (Bubonic Plague). Bubonic Plague can progress through the bloodstream to diverse parts of the body to cause meningitis, shock, bleeding, and pneumonia (secondary pneumonic plague).

**Transmission of infectious agent.** The most frequent source of human exposure is the bite of infected fleas. Other important sources include handling of tissues of infected animals. Persons with secondary pneumonic plague can spread the disease from person to person through respiratory droplets to cause primary pneumonic or pharyngeal plague.

**Incubation period of infectious agent** is from one to seven days but may be longer in immunized individuals; two to four days for primary pneumonia.

**Treatment of disease.** Streptomycin is the drug of choice; gentamycin is an alternate. Tetracyclines and chloramphenicol are other alternatives. All are effective if used early in the course of disease.

## **Anthrax**

Anthrax is an acute bacterial zoonotic disease that usually affects the skin but may also involve the mediastinum or intestinal tract. Vaccines are stockpiled. (page 20)

**Symptoms of exposure.** Skin exposure: itching of exposed skin surface, followed by a lesion that at first becomes papular, then vesculated, and develops into a depressed black eschar in two to six days. This eschar is usually surrounded by mild to moderate edema and sometimes small secondary vesicles. The inhaled anthrax presents symptoms resembling a common upper respiratory tract infection (URI) at first, with acute symptoms of respiratory distress following. X-ray evidence of mediastinal widening, fever, and shock follow in three to five days, with death ensuing shortly thereafter. Ingested anthrax presents with abdominal distress followed by fever, signs of septicemia, and then death in a typical case.

**Transmission of infectious agent.** Cutaneous exposure occurs when handling dying infected animal tissue, contaminated hair, wool, hides, or products made from infected, slaughtered animals. Inhalation anthrax results from inhaling anthrax spores. Intestinal exposure is caused by ingestion of infected meat.

**Incubation period of infectious agent** is from a few hours to 7 days, with most cases occurring within 48 hours after exposure.

**Treatment of disease.** Penicillin is the drug of choice and is given for five to seven days. Tetracyclines, erythromycin, and chloramphenicol are also effective.

### **Rickettsia – Query Fever (Q Fever)**

Q Fever is an acute rickettsia disease characterized by fever. Vaccines are not stockpiled for general use, but can be obtained from the U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD. (page 281)

**Symptoms of exposure** are sudden onset of headache behind the eyeballs, general weakness, and severe sweats, chills, and malaise.

**Transmission of infectious agent:** carried by domestic animals (cattle, sheep, goats) and ticks. Spread by airborne dissemination of infected excreta and also by direct contact with infected animal products (wool, straw, milk) and excreta.

**The incubation period of infectious agent** depends on the size of the infecting dose; however the usual incubation period is 2 to 14 days. Q Fever generally occurs as a self-limiting, febrile illness lasting two days to two weeks.

**Treatment of disease:** tetracyclines administered orally and continued for several days after the patient is afebrile; reinstitute if relapse occurs.

### **Toxins**

Toxins are chemical compounds of biological origin that may be lethal or incapacitating on skin contact or when inhaled or ingested. They are high molecular weight proteins capable of reacting with the human immune system antibodies. The recognition of a toxin attack and identification of a specific toxin present serious problems in a tactical deployment.

**Sources of toxins.** Toxins are naturally produced by bacteria, marine plankton (dinoflagellate), marine animals, plants, and fungi.

**Mechanism of action.** Generally speaking, toxins affect the body through mechanisms which cause reactions similar to nerve, blister, vomiting, and choking agents.

- **Cytotoxin.** Toxins that destroy or interfere with metabolic processes fall into this general description. A cytotoxin can affect the digestive tract, respiratory system, circulatory system, or the skin. Some effects may appear associated with blister, choking, or vomiting agents.

- **Neurotoxin.** The neurotoxins that are postsynaptic acetylcholinesterase inhibitors will induce nerve agent like symptoms. These postsynaptic neurotoxins cause ion channel permeability. Convulsions and pinpointing of pupils are the most noticeable symptoms. Some neurotoxins that are presynaptic inhibitors block the release of acetylcholine. Usually the symptoms associated with these presynaptic inhibitors are flaccid or limp paralysis, blurred vision, light sensitivity due to dilation of pupils, tremors, and confused behavior.

**Medical care.** In a field environment, only supportive care is available. The critical fact to remember is that antitoxins for many toxins are available, but specific identification of the toxin must occur, and this will not happen in a field setting. If toxin exposure is suspected, evacuation must occur as rapidly as possible.

### **Botulism**

Botulism is a severe intoxication resulting from ingestion of botulism toxin. Ingestion usually occurs as a result of eating contaminated food.

**Symptoms of exposure.** The symptoms are related primarily to effects on the nervous system. Blurred or double vision, difficulty swallowing, and dry mouth are the most common initial complaints. After the initial symptoms, an alert casualty can experience progressive, flaccid paralysis that moves downward through his body affecting the entire body evenly. The casualty may also experience vomiting, constipation, or diarrhea.

**Transmission of infectious agent.** The classic method of transmission of the botulism toxin is by ingesting contaminated food. The toxin grows in airtight packaging containing food products that have been improperly processed. Boiling destroys the toxin. No known person-to-person transmission of this toxic has ever been documented.

**Incubation period of infectious agent.** Neurological symptoms can appear within 12 to 36 hours and up to several days after ingestion of the toxin. The shorter the onset of symptoms, the more severe the disease and the higher the fatality rate.

**Treatment of disease:** intravenous and intramuscular administration as soon as possible of trivalent botulinum anti-toxin (types A, B, and E). The most critical aspect of effective treatment is placing the casualty in an intensive care unit so that respiratory failure, the usual cause of death, can be properly managed should it occur. The anti-toxin is available from the Centers for Disease Control (CDC).

## **Staphylococcal Enterotoxin B (SEB)**

The toxin SEB is one of several exotoxins (toxins found outside the bacterial cell) that are produced by *Staphylococcus aureus*. When ingested, SEB can produce symptoms of food poisoning. When inhaled, SEB causes a reaction described below which causes significant morbidity and potential mortality. (page 402)

**Symptoms of exposure.** Symptoms of respiratory exposure to SEB begin within 3 to 12 hours. The casualty can experience sudden onset of fever, chills, headaches, muscle pain, and nonproductive cough. When a severe exposure occurs, the casualty will have difficulty breathing and experience pain behind the sternum. Fever may reach 103°F to 106°F and last two to five days. Cough can last one to four weeks.

**Transmission of infectious agent.** Soldiers may be exposed to SEB after an aerosol attack because of the relative stability of the SEB toxin in air.

**Incubation period of infectious agent.** Symptoms occur within 3 to 12 hours after inhalation.

**Treatment of disease.** Treatment is limited to supportive care, including treatment of shock and lower hypoxia.

**Trichothecene mycotoxins.** These toxins act immediately on the eyes and skin by causing irritation, followed rapidly by death or a prolonged period of continued illness with death occurring weeks later. Death is usually caused by bone marrow suppression, liver failure, or internal bleeding. Within 10 to 30 minutes after exposure, the individual experiences vomiting, dizziness, rapid heart beat, and chest pain. Within hours, the individual can experience bloody vomiting, bloody diarrhea, and if the exposure was on the skin, blistering.

## **Other Toxins**

- **Saxitoxin.** Produced naturally by the dinoflagellate plankton, this toxin kills within ten seconds.
- **Tetrodotoxin.** Produced by the newt, puffer fish, and blue-ringed octopus, this toxin is a rapid, lethal, neuromuscular blocker that acts within five minutes to one hour.
- **Palytoxin.** Produced by the coelenterate (soft coral animal), this toxin is a very rapid-acting, lethal neurotoxin that acts within five minutes. Symptoms are rapid muscle paralysis and collapse.
- **Ricin.** Produced from the castor bean seed, the activity of this toxin is delayed by 1 to 12 hours, but is a lethal cytotoxin that causes weakness, fever, cough, vomiting, and severe cramps. Ricin has been characterized as being 100 times more deadly than cobra venom.
- **Mycotoxins (fungus toxins).** Typical of this group of toxins is the trichothecene group that contains T2, nivalenol, and deoxynivalenol. Severe poisoning of these toxins causes ataxia, shock, collapse, vomiting, diarrhea, and death.

## FIELD MANAGEMENT OF CASUALTIES ON THE CONTAMINATED BATTLEFIELD

The single most important concern for the combat lifesaver/soldier medic during operations on the contaminated battlefield is the timely and proper management of casualties. Providing timely and proper management must begin with preparations long before deployment. The required preparations can be divided into several elements.

- Training individual unit members to correctly identify chemical agent exposure based on signs or symptoms and to correctly perform self-aid or buddy-aid and decontamination.
- Training the combat lifesaver and soldier medic to correctly identify any chemical agent based on observed signs or symptoms experienced by the casualty.
- Complete understanding of the severity of exposure based on signs and symptoms.
- Correct identification of route(s) of entry of the agent and method of exposure (from liquid and/or vapor) based on signs and symptoms.
- Triage chemical casualties or mixed conventionally wounded and chemically contaminated and/or poisoned casualties for mass casualty situations.
- Correct treatment of agent effects, proper use of antidotes, and other supportive care that may be required during or after initial treatment (i.e., assisted ventilation or airway suction).
- Complete understanding of the various casualty types that can be encountered on the contaminated battlefield.
- Identification of required casualty decontamination, both at the initial treatment location and at the MTF.
- Complete understanding of ambulatory and litter casualty decontamination operations at the MTF.
- Identification of personnel limitations and equipment shortfalls in support of casualty decontamination and treatment.
- Understanding the impact of contaminated and/or decontaminated casualties on evacuation operations.

Once deployment is complete, the combat lifesaver/soldier medic must be aware of additional elements that also impact on management operations. These battlefield elements, at a minimum, are as follows:

- Current enemy chemical capabilities, enemy chemical employment capabilities (i.e., artillery, rockets, or spray), and anticipated enemy chemical employment.
- Tactical intelligence gathered after the verified enemy use of chemical agents.
- Current protective posture of the unit and how vigorously it is maintained.
- Current status of unit and individual chemical defense readiness.
- Morale and confidence of individual unit members, both in the unit and each other.
- Complete understanding of current and near-term combat operations.

All of these elements, when considered together, allow the combat lifesaver/soldier medic to take a proactive readiness posture for management operations on the contaminated battlefield. The following sections will expand on these elements.

## TRAINING

All individuals, both medical personnel and non-medical augmentees, who are involved in the patient decontamination effort must be trained in, or show proficiency in the following:

- Drink from canteen while wearing your protective mask.
- Recognize signs or symptoms of heat injury.
- Recognize liquid chemical agent.
- Detect and identify chemical agent using M8 Chemical Detection Paper or M9 Chemical Detection Tape.
- Evaluate a casualty.
- Prepare decontamination solutions.
- Recognize signs or symptoms of chemical poisoning.
- Administer nerve agent antidote to self (self-aid).
- Administer nerve agent antidote and CANA to buddy (buddy-aid).
- Transport litter casualties using both two-man and four-man litter carries.
- Move casualty using logroll method.
- Remove litter casualty's contaminated clothing.
- Perform litter casualty's skin decontamination.
- Use Chemical Agent Monitor (CAM).
- Wound or injury management during litter and ambulatory decontamination.
- After initial treatment, route casualties to litter patient decon area.
- Remove ambulatory casualty's contaminated clothing.
- Monitor litter and ambulatory casualties for residual contamination after completion of decontamination process.
- Prepare the M8A1 Automatic Chemical Agent Alarm (ACAA) and/or the M22 ACADA for operation.
- Place the M8A1 ACAA and/or the M22 ACADA in operation.
- Use the M256A1 Chemical Detection Kit.
- Conduct unmasking procedures using the M256A1 Chemical Detection Kit.
- Decontaminate open wounds.
- Identify chemical agent causing signs or symptoms.
- Treat chemical agent poisoning.
- Describe and perform emergency medical treatment required to stabilize a casualty for the decon process.
- Identify triage requirements based on signs or symptoms.

The list above is suggested as a starting point for a training program to support casualty decontamination operations. The list has obvious tasks that are medical only

and should only be taught to medical personnel. However, some tasks are applicable to all and should be taught to all.

## EXPOSURE HISTORY

An important informational link between the soldier and the MTF will be the history surrounding the exposure, the soldier's activities since the exposure, and the progression of symptoms. The following questions may be helpful:

### **At Time of Exposure:**

- Did M9 Chemical Detection tape react?
- Was agent verified in liquid or vapor or a combination of both?
- How was the agent identified and verified?
- What actions occurred and when did they occur in relation to the time of detection? (i.e., skin decon, flushing eyes, etc.)
- What level of MOPP was the casualty wearing at the time of exposure?
- If not at any MOPP level, did the casualty don the MOPP over his exposed BDU?

### **After Onset of Symptoms:**

- Were MARK I Kits and/or diazepam used, and if so, when in relation to the onset of symptoms?
- Has the soldier been taking the Nerve Agent Pretreatment Pill (NAPP)? When did he take the last one?
- How long since the last onset of symptoms?
- What symptoms has the casualty experienced?
- What activities has the individual engaged in since the initial exposure?
- What was the casualty doing when the symptoms began?
- What level of MOPP was the casualty in when symptoms began?

Knowing the soldier's protective posture at the time of exposure, the time taken to react to the exposure, and the actions taken by the soldier in response to the exposure will assist the triage effort and subsequent treatment effort at the MTF. Obtaining as complete a history as possible, coupled with unit chemical survey data, will enhance the triage and treatment effort for the casualty at the MTF. Providing too much information on the field medical card is far better than not providing enough.

The combat lifesaver/soldier medic must also be aware of the various factors influencing production of the casualty types. These factors are as follows:

- The protective posture of the unit at the time they encountered the chemical agent.
- To what extent was the unit surprised by the encounter, regardless of how the encounter happened?

- Was the encounter a result of movement through the chemical contamination or a result of direct attack on the unit?
- Was movement through the chemical contamination deliberate or unintentional?
- Was the unit in contact with enemy forces at the time of the encounter?
- Did the unit encounter chemical agents in vapor form only, liquid form, or a combination of both?
- Has the unit's chemical survey team verified the agent?

Understanding the circumstances surrounding the production of the casualty will help the combat lifesaver/soldier medic in the casualty's triage, treatment, and evacuation.

## CASUALTY EVALUATION

The combat lifesaver/soldier medic will encounter seven general categories of casualties on the contaminated battlefield. They are listed below.

- Poisoned and contaminated
- Poisoned and not contaminated
- Conventionally wounded, poisoned, and contaminated
- Conventionally wounded, poisoned, and not contaminated
- Conventionally wounded, not poisoned, and contaminated
- Conventionally wounded, not poisoned, and not contaminated
- Psychological

This list may seem obvious at first, but it is presented for a reason. The proper management of casualties must begin with an in-depth understanding of the various types of casualties and the specific treatment needs of each.

When the combat lifesaver/soldier medic is confronted with one or more casualties on the contaminated battlefield, a deliberate decision-making process must begin. Taking deliberate steps to evaluate the casualty, regardless of condition, will allow him to be triaged into the correct category. This, in turn, will optimize the casualty's care and his chance of eventual return to duty.

At times, the combat lifesaver will need to decide which course of action to follow. The deciding factor will always be to treat the condition that poses the most immediate threat to life and limb. The most critical step of the decision-making process is triage.

## TRIAGE ON THE CONTAMINATED BATTLEFIELD

Triage is defined as the classification of patients according to type and seriousness of injury in order to provide the most orderly, timely, and efficient use of medical resources while providing maximal casualty care. Triage is necessary during a mass casualty situation or when the casualty load overwhelms medical resources. Under this circumstance, it is necessary to sort and prioritize patients for care. When the number of casualties does not overwhelm medical resources, triage is not necessary.

During a mass casualty situation, the goal is to provide the best care for the most casualties. Ideally, care would be provided first for those who are in immediate danger of dying because of their wounds. However, this can be done only if resources to provide this care are available **and** if the care will not require an undue amount of time that might be spent caring for other casualties.

Guidelines for surveying a chemical casualty prior to triage are provided below. Chemical casualties may also have conventional wounds, and standard guidelines for the initial survey of a casualty must also be followed. These guidelines should be discussed with the medical officer in your unit and modified accordingly.

### **Surveying the Casualty**

- Observe the self-aid or buddy-aid rendered for both conventional wounds and/or chemical agent poisoning.
- Question the casualty's buddy regarding the following:
  - Type of agent and how it was identified
  - Initial signs/symptoms
  - Conventional wounds noted in casualty by buddy and buddy-assisted first aid rendered
  - Prior treatment for suspected chemical poisoning and/or conventional wounds
  - Use of nerve agent pretreatment drug (pyridostigmine)
- Observe the casualty's protective clothing and equipment for signs of liquid chemical contamination.
- Observe the casualty's M9 Chemical Agent Detector Paper for pink, red, reddish brown, or purple color changes. The generation of a wound at the time of chemical agent exposure may also result in liquid agent being deposited into the wound, in which case the liquid chemical agent probably has begun to absorb into the tissue. Exposed skin may also be absorbing agent.
- Observe the casualty closely for small liquid droplets on butyl rubber surfaces (protective boots, gloves, mask hood, and helmet cover). Survey the casualty's weapon for liquid droplets. Place M8 Chemical Detection Paper on the liquid. Refer to the M8 booklet cover for liquid agent identification based on color change.

(Perform this step **only** if evidence of liquid chemical agent contamination is observed on the M9 paper, BDO, or equipment and has not been identified by the section or platoon chemical survey team. This step can wait until triage action on the casualty is complete and must be performed by the combat lifesaver/soldier medic. Results must be written on the Field Medical Card.)

- Survey casualty for conventional injuries.
- Survey casualty for continued signs/symptoms of chemical agent poisoning.
- Determine whether or not the casualty can respond to a command.
  - Ask the casualty to describe signs and symptoms.
  - Observe whether or not the casualty responds in an orderly fashion when following simple directions. Suspect shock or CNS involvement if he cannot.
- Observe the casualty for the following symptoms:
  - "Sweating" through the overgarment or through exposed skin; this could indicate a skin exposure to liquid nerve agent under the "sweat."
  - Labored breathing
  - Coughing
  - Vomiting
- Check pulse by placing fingers on carotid. This might be done by feeling through the hood. If no aerosolized agent is still in the air, the triage officer, wearing the **tactile** chemical protective gloves, might reach under the hood and feel for the pulse on bare skin. After unfastening the arm strap of the hood and unzipping the hood, the **tactile** gloves and the skin on the neck should be decontaminated before feeling for the carotid pulse.
- Check for pupil reactivity by covering both eye lenses with gloved hands, then uncovering and observing for pupil reaction.

### **Triage the patient.**

Triage categories are **immediate**, **delayed**, **minimal**, and **expectant**.

#### **• IMMEDIATE**

A casualty classified as **immediate** has an injury that will be fatal if he does not receive immediate care. In a non-mass casualty situation, he would be the first casualty to receive care. However, in a mass casualty situation, particularly in a far-forward medical treatment facility, he may not receive this care. The required care may not be available at that echelon (e.g., a casualty may need major chest surgery, and that cannot be done at a BAS) or the time needed to provide that care may be so prolonged that other casualties would suffer. Examples of immediate casualties are provided below.

--Casualties who are not displaying signs and symptoms of chemical agent poisoning but have a life-threatening conventional injury (i.e., gross external bleeding,

sucking chest wound, flail chest, airway obstruction, tension pneumothorax, maxillofacial wounds in which asphyxia exists or is likely to occur).

--Severe nerve agent casualties with or without conventional wounds. This would include those who have labored breathing or just stopped breathing but still have adequate circulation (a good blood pressure) and those who are convulsing or have convulsed.

--Casualties from cyanide poisoning who are gasping or just stopped breathing, but still have adequate circulation.

-- Casualties in respiratory distress from phosgene, a phosgene-like substance, or a vesicant. The care required for these casualties exceeds that at the lower echelon medical treatment facilities. They should be triaged as immediate only if they can be quickly evacuated to a pulmonary treatment facility for intensive care.

#### • **DELAYED**

A **delayed** casualty is one who needs further medical care but can wait for that care without risk of compromising his successful recovery. He may require extensive surgical procedures and long-term hospitalization, but he is presently stable and requires no immediate care. A casualty with a leg wound or fracture is an example of a conventional casualty who would be delayed. A casualty recovering from severe nerve agent poisoning will be delayed. Most casualties with vesicant burns will be delayed.

#### • **MINIMAL**

A casualty who would be classified as **minimal** is one who (1) can be treated by a medic and does not need to see a physician or physician's assistant, (2) will not be evacuated, and (3) will return to duty within a day or so. Such casualties might be as follows:

-- Casualties with moderate to mild nerve agent poisoning who have taken the antidote, are recovering, and are not in distress.

-- Casualties who have minor conventional wounds.

-- Blister agent casualties with a small amount of erythema or a few small blisters in noncritical areas.

#### • **EXPECTANT**

The **expectant** casualty is one for whom medical care cannot be provided at the medical treatment facility and cannot be evacuated for more advanced care in time to save his life. This category is used only during mass casualty situations. This category does not mean that these casualties will not receive medical care.

• Transfer casualties for treatment/evacuation based on established priorities for treatment.

-- Casualties who have been classified as “IMMEDIATE” are transferred to the contaminated medical treatment area for stabilization. After stabilization, these casualties are taken to the litter patient decontamination area.

-- Casualties who have been categorized as “DELAYED” may or may not require treatment in the collective protection treatment area before evacuation. If they need to enter this clean area for treatment, they are sent to the ambulatory or litter decontamination line, whichever is appropriate. If they do not need treatment in this area, they are sent directly to the evacuation holding area.

-- Casualties who have been categorized as “MINIMAL” may receive treatment in the collective protection treatment shelter or the contaminated emergency treatment area. If they can be treated in the contaminated emergency treatment area and they have no break in their BDO, they will be returned to duty from this area. If they require treatment in the clean treatment area, they will need to be sent to one of the decontamination areas before entry into the area. If there is a break in their BDO, they will need resupply. They must go through decontamination to the clean treatment area for resupply (resupply will be their own second BDO; if they do not have a second BDO, they will require evacuation for resupply).

-- Casualties who have been categorized as “EXPECTANT” will be transferred to designated contaminated holding areas. These casualties will be constantly monitored while in this area and provided with available comfort measures.

## AMBULATORY AND LITTER PATIENT DECONTAMINATION

Patient decontamination is a labor-intensive undertaking and will require augmentation personnel, additional or specialized equipment, and training for all personnel involved. Proactive planning will go far to minimize the impact on your unit and ensure the overall medical mission is not impaired. With a little ingenuity, training, and aggressive execution, an effective litter patient decontamination procedure can be established.

### KEY ELEMENTS

When planning for patient decontamination operations, the following key elements must be considered:

- Wind direction
- Security of decon site
- Access control to decontamination site
- Equipment/supplies
- Personnel requirements
- Work/rest considerations
- Establishing a patient decontamination station
- Litter casualty decontamination procedures
- Ambulatory casualty decontamination procedures
- Disestablishing a patient decontamination station

#### ***Wind Direction***

Wind direction and speed are critical factors in planning because of the vapor hazard that will be present downwind from the Chemical Decontamination Center (CDC). When planning for patient decontamination, the assumption must be made that, after decontamination operations begin, chemical agents in vapor and liquid form will be present in the patient decontamination site (i.e., open dirty dump, patient arrival and triage area, etc.). Consideration must be given to the effect that wind-driven chemical agent vapors have on other unit operations or on other co-located units. A valid concern of other unit commanders and your commander will be the uncontrolled effect vapors have. This one factor may cause you to plan for decontamination outside the unit area.

Knowing the anticipated wind direction and wind speed, plus the estimated duration for the direction and speed, will allow for a swift response to incoming chemical casualties. The wind information you will need can be obtained from the chemical officer or NBC NCO who get this data from the Chemical Downwind Message (CDM). This data can also be obtained from the S2/G2. The decontamination site will therefore initially be set up to take advantage of the prevailing wind, with clean area operations

always upwind. In the event the predicted wind data shows a radical wind shift is predicted during decontamination operations, your set-up should be adaptable to allow for quick rearrangement.

Keeping track of the existing wind direction during the decontamination operation is the responsibility of the site Noncommissioned Officer in Charge (NCOIC). One of the best means of doing this is to attach short strips of the yellow marking ribbon to mounting stakes from the M274 NBC Marking Set or white engineering tape to tent poles, tent ropes, etc. One of these wind direction devices must be visible from the hotline when looking in any direction.

If the wind shifts more than 30° from the prevailing wind direction, consideration must be given to shifting the decontamination site. Wind shifts often are transient, so it is advisable to wait 10 to 15 minutes to see if the wind goes back to its original direction. Coordination for the disruption of patient flow and diversion during this waiting period should be considered in the preplanning phase.

Often wind speed will be less than 5 KPH for long periods of time. During these calm atmospheric conditions, chemical agent vapors will drift in almost any direction. This lack of wind direction will also require the planner to consider moving the decontamination site well outside the base cluster or support areas so as to not adversely affect other units or the on-going conventional medical mission of the MTF.

### ***Security of Decontamination Site***

When choosing a decontamination site, the same security considerations must be given as for any other site chosen for medical operations. The decontamination site is at the same potential risk from attack as the MTF. The Officer-in-Charge (OIC)/NCOIC can evaluate the risk by asking the following questions:

- What is the commander's estimate of possible enemy contact?
- What is the S2's intelligence on enemy weapons and tactics?
- What terrain or structures can be used to enhance the defense of the decontamination site?
  - Can the site be defended?
  - Is the site overly accessible, e.g., is it sitting on a hill; can the site be visually acquired from a distance?
  - Can the site be quickly evacuated if necessary?
  - Can key locations be sandbagged for added protection?
  - Will the site be located in an area under light discipline?
  - Will the decontamination operation be functional in complete darkness?
  - Are communication means available for medical or operational emergencies?

### ***Access Control to Decontamination Site***

An **entry control point (ECP)** must be established to control movement of all facilities into the MTF or the CDC. The ECP should be located at a distance far enough from the MTF to minimize any vapor hazard that may occur from contaminated vehicles stopping at this point. Without extensive chemical agent monitoring ability, rapid decisions must be made as to which vehicles and vehicle contents are contaminated and must proceed to the decontamination site, and which are clean and may proceed directly to the MTF. To facilitate identification of evacuation vehicles carrying clean or contaminated casualties, prior direct coordination between the MTF and supporting evacuation units, both air and ground, on a standardized identification method must occur. This coordination should happen prior to deployment.

One solution is to use fabricated metal triangles with the NATO standard dimensions of 28 cm x 20 cm x 20 cm. To maximize camouflage, the triangles should be painted with flat green CARC paint. On the three separate triangles, the words ATOM, BIO, or GAS would be painted in flat black CARC paint. This will give the evacuation vehicle crew the ability to designate what casualty type is on board. The triangle would be attached to the front end of the evacuation vehicle so the ECP personnel could observe it at a distance. For night operations, chem-lights can be used. A yellow chem-light is used for chemical casualties, blue for biological casualties, and red for radiation casualties. The chem-light would be attached to the front end of the vehicle below the level of the hood to preclude its interference with the driver/TC's night vision.

The soldiers manning the ECP should be equipped with a pair of binoculars and night vision goggles (NVG) for standoff inspection of the approaching evacuation vehicle. Once the vehicle halts at the ECP, the ECP personnel should conduct a cautious approach of the vehicle. They should note the MOPP Level the evacuation vehicle crew is in and (regardless of MOPP Level) question the crew about any signs or symptoms of agent exposure and about the vehicle's contamination status.

M8 or M9 paper may be used to make a rapid and accurate determination of whether or not a liquid chemical agent is present on or in a vehicle. Visual inspection of the vehicle can be done at the ECP. When suspect liquids are found, M8 paper should be placed in the liquid and the results noted and sent to the MTF Headquarters. Areas likely to have liquid contamination are the vehicle's wheel well areas, tires, and rear portion of the vehicle. If patient decontamination is to be accomplished within the unit area and the evacuation vehicle is found to have exterior contamination, plans must be established to transfer casualties to the casualty decontamination site via clean 2-1/2 or 5 ton trucks. The commander may want to restrict vehicles with exterior contamination from moving through the unit area. Litter teams may also be utilized to transfer casualties. As a final resort, the contaminated evacuation vehicle may be routed into the casualty decontamination site on a route that has minimal impact on vehicle movement into the MTF after decontamination operations are concluded.

**Control of vehicle movement** to specific routes and areas within the decontamination site is a critical safety issue, even during combat operations. This can involve routing vehicles along a clearly marked, one-way path for the ECP to the

chemical casualty decontamination site. Then, ideally, return to the ECP should be along the same route. If vehicles are not kept on the proper path, clean areas are likely to become contaminated, and both patients and personnel are subject to being run over during night operations. Planning for vehicle movement must always include night operations and low visibility conditions.

**Control of personnel movement** is necessary to ensure that casualties and site personnel do not accidentally cross the hotline without first being decontaminated. Concertina wire works well to keep personnel in the desired areas, and a clearly marked, one-way route helps to ensure that correct entry and exit points are used. To reinforce physical barriers, night operations must rely more on visual control measures that conform to light discipline guidelines.

### ***Equipment and Supplies***

A suggested minimum list of additional items needed to support the casualty decontamination site is provided at Appendix B.

### ***Personnel Requirements***

Provided below is a minimum suggested list of personnel to staff the CDC. Although a fully effective litter decontamination procedure can be performed by just two augmentees, and triage can be handled with minimal staff, planning must include staffing for both the operational and support staff. The in-depth planning required for manning the decontamination site must include the anticipated casualty load, day or night operations, weather conditions, work and rest rates for personnel, logistical support for the site, and the acceptable impact on conventional medical operations that are still on-going.

#### **Site Command and Control Cell:**

- 1 Officer
- 1 NCOIC

#### **Triage/Emergency Medical Treatment Area:**

- 1 EMT NCO as Triage Officer
- 1 EMT
- 8 Litter Bearers

#### **Litter Casualty Decontamination Area:**

- 1 Chemical Agent Monitor (CAM)
- 4 Decontamination Augmentees
- 1 EMT

**NOTE:** The four decontamination augmentees assist in moving patients between clothing removal and skin decontamination litters. They can also replace litter bearers during casualty decontamination as needed, remove contaminated litters, and replace clean litters during transfers between clothing removal and skin decontamination. Additionally, the augmentees bag waste from the litter decontamination area, replace chlorine solutions after every two patients, and pour old chlorine solutions onto waste in the bags, thus allowing the liquid to absorb into the clothing.

**Ambulatory Casualty Decontamination Area:**

4 Decontamination Augmentees  
1 Medic

**Litter Decontamination Point:**

Not manned

**NOTE:** Augmentees decontaminate the litters by scrubbing a 5% chlorine solution over the entire surface. If canvas litters are used, the augmentees will remove any barrier materials used to protect the wooden handles and canvas cover and place these materials in a plastic bag. The augmentees must scrub the canvas litter with 5% chlorine solution and reapply new barrier materials. Separate litter cycles must be maintained. Clothing removal litters must not be used as skin decontamination litters. When not decontaminating a litter, two of the augmentees will transport waste to the dirty dump.

**Clean Treatment Area:**

2 Litter Bearers  
1 EMT

**Logistical Support Point:**

1 Medical Supply NCO  
1 Soldier

**TOTAL: 27 Soldiers**

***Work/Rest Considerations***

This single consideration will impact directly on the efficiency of personnel and replacement needs of personnel. A complete understanding of the available information on this subject, coupled with common sense and experience, will enhance the planning process and address manpower needs. Establishing a work/rest cycle is dependent on several factors, as listed below.

- How rested are the soldiers?
- Have the soldiers been acclimated?
- Has a command drinking policy been in effect regardless of MOPP Level, thus affecting how well hydrated the soldiers are?
  - What is the anticipated relative humidity?
  - What is the anticipated temperature?
  - Will overhead cover (shade) be available?
  - How many heat casualties will the commander accept?

Suggested background information can be found in FM 3-4, NBC Protection, Chapter 2, MOPP Analysis.

***Establish a Patient Decontamination Station***

Medical support on the future battlefield will be robust, versatile, and extremely mobile, regardless of the echelon of Health Service Support (HSS). The care of contaminated casualties, although more complicated than that of conventional casualties, must not stop the on-going medical mission. Medical officers and medical NCOs must develop realistic, battle-focused plans. They must then refine and validate these plans in challenging training if HSS on the future battlefield is to be successful.

The single area of contaminated casualty care that has in the past caused the greatest amount of trouble for medical units has been the actual decontamination effort. Beginning with this section, through the final section on disestablishing a decontamination site, you will be presented with material derived from recently

conducted tests, doctrinal procedures, and the practical experiences of medical and chemical NCOs. The following section presents suggestions or “food for thought” on how to successfully conduct contaminated casualty decontamination.

Before we get into the actual material on establishing a decontamination site, it is important to discuss where these contaminated casualties originate. A picture of the C/B battlefield is required if planning is to anticipate, with some degree of accuracy, the appropriate level of preparation required for casualty decontamination and care.

### **The C/B Battlefield**

Initially, all chemical agents are disseminated as liquids or solids. Chemical agents can be introduced into the environment as one of the following, depending on the weapon system used:

- Solids
- Liquids
- Gases/Aerosols

Biological agents can be introduced into the environment in wet or dry form. Examples are provided below.

- Aerosols
- A slurry mix (wet)
- Large thick drops
- A dry powder
- Spores
- Vectors

Regardless of which form a C/B agent is in when introduced, there is one common result – chemical or biological weapons will contaminate personnel, terrain, and equipment on the ground. However, it is not enough to say that contamination occurs. It is also important to discuss the extent of the contamination and how long it will last.

### **Chemical Contamination**

The most common misconception people have about chemical contamination is that vast areas of the battlefield will be contaminated by liquid chemical agents. Another misconception is that everything in the contaminated area will be “dripping” with chemical agents. The method for predicting the affected areas from a chemical attack is presented in FM 3-3, Chemical and Biological Contamination Avoidance, Chapter 3. The contamination prediction tells two important things about a chemical attack. First, it shows the attack area, i.e. the area in which liquid contamination can be found. Second, it shows the hazard area, i.e. the area downwind from the attack area that can be affected by chemical vapors originating in the attack area. The prediction also

shows whether the attack was an air contaminating attack (Type A), which has little or no liquid contamination on the ground, or a ground contaminating attack (Type B).

Casualties in the attack area will pose the greatest risk during initial medical treatment and patient decontamination because of the potential liquid contamination that may be cross transferred to the soldier medic/combat lifesaver, the interior of evacuation vehicles, or non-medical augmentees performing patient decontamination. Casualties in the hazard area do not pose liquid chemical agent complications; however, they do pose a problem from off-gassing chemical vapors trapped by the BDO. Because of these liquid and vapor problems, it is important to understand as much as possible about the attack and hazard areas.

The dimensions of the attack area based on the type of agent employed and weapon system used are provided in FM 3-3. The dimensions represent an area that will be larger than the actual area contaminated by a liquid chemical agent. The following illustrates this point:

### Type A Attack

Artillery shells or multiple rocket launchers	Attack area radius = 1 km
--	------------------------------

### Type B Attack

Artillery shells	Attack area Radius = 1 km
Missile attack with high airburst	Attack area radius >1 km, but <2 km
Spray attack or regimental artillery attack	Attack area radius = 2 km Attack length > 2 km

**NOTE:** In the spray attack or artillery attack by several artillery regiments, the Type B attack area is predicted to be shaped like a cylinder. Although it can be several kilometers in length, it will be no more than 2 km wide at any point. This type of attack will contaminate the greatest area of all the attack types shown.

The Type A attack occurs when threat forces believe that a large concentration of chemical agent vapors will surprise U.S. forces and cause casualties through inhalation. This attack usually is conducted by firing large numbers of highly volatile (non-persistent) chemical agent munitions into a relatively small area.

These nonpersistent agents are:

Nerve Agents – GB, GD  
Pulmonary Agent – CG  
Vesicating Agent – CX  
Cyanide Agents – AC, CK

The Type A attack will not normally be placed on a unit's position but will occur "off-target," i.e. at some distance away from the unit so as to maximize the development of a vapor cloud and the number of casualties through inhalation. This will be particularly true of an attack that uses the G-series nerve agents, the pulmonary agent CG, or the vesicating agent CX. However, should a cyanide agent be used, the attack will most likely be in or extremely close to a unit's location because of the rapid expansion of cyanide vapor in the air and the ability of cyanide vapor to mix easily with the surrounding air.

A casualty in the Type A attack area presents a potential liquid hazard as well as an off-gassing vapor hazard, while the casualty in the Type A hazard area will pose only an off-gassing hazard. However, in most cases, any liquid chemical agent found on this casualty will be minimal due to the rapid evaporation of the highly volatile (nonpersistent) liquid chemical agents from the outer material of the BDO. Although the M9 chemical detection tape worn by casualties in the attack area will show a positive color reaction to any liquid chemical agents that he has been exposed to, it may be difficult to detect and identify the agent using M8 detection paper during triage at the decontamination site because of evaporation.

The Type B attack occurs when threat forces believe that terrain denial or the creation of a chemical barrier will slow U.S. forces or cause our forces to maneuver around the obstacle, potentially into a pre-planned killing zone. The use of a Type B attack on choke points (i.e., narrow points in a valley, road junctions, or crossing points at water obstacles) can be expected, especially if U.S. forces are in these locations. Threat forces will use chemical agents with a low volatility (persistent). The persistent chemical agents are as follows:

**Nerve Agents** - TGD (thickened GD), VX  
**Vesicating Agents** - L, H, HD

The Type B attack area can be several times larger than the Type A area. The Type B attack represents the worse case scenario for medical support because of the long-term hazard posed by liquid chemical agents. The Type B attack is used for planning purposes until deliberate chemical surveys indicate a Type A Attack has occurred. Also, the Type B attack is most likely to be placed on or near our units to maximize the effect liquid and heavy vapor contamination will have on our personnel and equipment.

A casualty caught in the open without overhead cover during a Type B attack will have easily visible, oily splashes or a large number of oily spots of varying sizes on the

BDO. The mask carrier, load-bearing equipment (LBE), and protective mask hood will also have spots or smears that cannot be a result of perspiration. The M9 detection tape may also have positive indications of chemical agent drops (some as small as 100 microns) and a few streaks.

After the actual attack has stopped, the agent may smear on the casualty's BDO and appear entirely different than perspiration. The liquid chemical agent may also appear on the mask carrier, LBE, and protective hood as an oily smear or singular oily spots of varying size. The M9 detection tape will have more streaks than spots, which could indicate the casualty brushed against the liquid while moving or being carried.

Casualties in the hazard area of the Type B attack will pose the same hazard as a Type A casualty, i.e., off-gassing vapors from the BDO.

### **Biological Contamination**

While the information available on chemical contamination is extensive, the same cannot be said for biological contamination. Because of the incubation period of biological agents, our forces may not know that a biological attack has occurred, or even which biological agent was used, until several days to a week after the attack has actually occurred. This basically means that the prediction method in Chapter 4 of FM 3-3 will be used to assess what terrain was potentially contaminated, which units were present in the predicted area or contamination, and how long these units remained in the affected area. Knowing which units were in the area will allow for a medical response that is appropriate for the agent used and the anticipated casualty load.

In Chapter 4 of FM 3-3, two types of biological attack are presented, the Type A attack (air contaminating attack) and the Type B attack (ground contaminating attack). The Type A attack is considered the worst case scenario and is used for planning purposes because this type of attack will contaminate the great amount of terrain and affect the greatest number of personnel. The attack area for a Type A attack is always 1 km in diameter (unless a larger size is observed or determined through a survey), while the total downwind distance of the Type B hazard can vary from 32 km out to several hundred kilometers.

The total downwind distance will produce a hazard area of enormous proportions. Any casualty from any location within the attack area or hazard area that requires medical support must be considered contaminated and handled appropriately. This standard response should continue until deliberate biological sampling has taken place and the laboratory analysis of the samples indicates that the biological threat no longer exists.

The Type B attack will have only an attack area, which will be shown as a circle with a minimum diameter of 5 km unless a larger size is determined through a survey or by observation. Any personnel from within this circular attack area who require medical support must be considered contaminated and handled appropriately.

## **Tactical Planning**

When a C/B attack occurs on or near the unit a medical platoon is supporting, the medical platoon leader (field administrative assistant) and the medical platoon sergeant must be prepared to quickly and efficiently transition from conventional casualty operations to contaminated casualty operations. To accomplish this transition, the medical platoon leader or medical platoon sergeant must be alerted almost as quickly as the unit commander that a C/B attack has occurred. In order for this information to be obtained in the quickest fashion, one of these personnel must be located in the unit tactical operations center (TOC). He must monitor both the unit's internal command (COM) radio net and/or the admin/log (A/L) radio net. When an attack occurs, a NBC-1 (CHEMICAL) Observers Report will be sent, or a code word will be sent via the COM or A/L radio net. This will alert the unit that a chemical attack has occurred. Because the unit NBC NCO or chemical officer will lack vital C/B survey information during the first hour or so after an attack has occurred, it must be assumed that, in the case of a chemical attack, a Type B attack has occurred. Likewise, in the event a biological attack is suspected, a Type A attack must be assumed.

The medical response must begin with a hasty evaluation of the attack, the factors that can indicate the type of casualties most likely to be seen, and the type of contamination these casualties will bring in with them - liquid vs. vapor, chemical vs. biological. This evaluation will be based on the following:

- The location of all units supported by the medical platoon.
- The location of the attack (Line F of the NBC-1 Observers Report).
- The type of agent and type of attack (Line H of the NBC-1 Observers Report. If Line H is unknown, then assume a Type B attack.)
  - Which units are in the attack area?
  - Which units are in the hazard area?
  - The readiness posture of any unit inside the predicted attack area and/or predicted hazard area.
    - What MOPP level was the affected unit in?
    - What type of terrain has the unit occupied?

Built-up (urban) terrain could indicate that overhead cover was available to shield personnel against the initial liquid contamination. Wooded terrain could also indicate some overhead cover provided by the forest canopy. Desert terrain indicates very little overhead cover.

- How long had the unit been in its position?
- If nerve agent is suspected, was the unit taking Nerve Agent Pyridostigmine Pretreatment (NAPP)?
- If nerve agent is reported, how was the agent verified? M8A1, M22 ACADA, and/or M256A1 detector sampler indicates **ONLY** a vapor hazard. M8 detector paper

indicates **ONLY** a liquid hazard. Any combination of M8 detector paper, the M8A1, M22 ACADA, and M256A1 detector ticket indicates both a liquid and vapor hazard.

- Is the attack only a chemical attack, or are conventional High Explosive (HE) munitions being used alone or along with a ground attack?
- If a biological attack is suspected, what were the indicators?
  - Did any suspicious liquid fail to cause a reaction on M9 or M8 paper?
  - If aerosols were observed being disseminated, did the M8A1 ACAA, M256A1 chemical detection sampler, or CAM fail to indicate a chemical agent?

These questions are by no means all that can be asked but are critical in determining a hasty plan of action. The unit's executive officer must be notified that contaminated casualties will be arriving and that some evacuation assets may be contaminated. The executive officer will, in most situations, make the final decision if the decontamination of casualties will take place within the unit area or if it must take place at a location outside the unit area that will not affect ongoing support operations.

### **Establish the Decontamination Site**

The ability of the medical platoon, or more specifically the treatment squad, to establish the decontamination site will depend greatly on unit support. Long before the medical platoon deploys, the unit commander, first sergeant, and executive officer must understand the need for manpower and equipment support. Also, when possible, the commander should pre-designate in the tactical SOP (TSOP) which sections of the headquarters unit will provide personnel or equipment. The medical platoon leader should ensure that the sections tasked to provide personnel are trained prior to deployment and that after deployment; these sections receive quick refresher training when possible.

When a C/B attack occurs, the required personnel and equipment must be available almost immediately. The medical platoon leader or platoon sergeant must maintain a current status of required support equipment and a continuously updated roster (by name) to ensure that gathering of personnel and equipment can occur when a timely response is critical to patient care.

**Outside a 1 km stand-off distance from the edge of the predicted downwind hazard area**, all personnel can remain in MOPP II during the set-up of the decontamination site. In this area, the site should be free from both liquid and vapor contamination. It is recommended that one soldier in MOPP IV conduct continuous monitoring during site set-up at a location at least 1 km away. This soldier should use both the M8A1 ACAA, or the M22 ACADA and M256A1 chemical detector kit regardless of what agent has been reported. Initial NBC-1 Observers' Reports received at the TOC during testing scenarios and field training exercises often contain incorrect information on which agent was actually encountered. As long as the monitor continues to report no contact with chemical agent vapors, all personnel can remain in MOPP II until the first casualties are five to ten minutes away.

**If the selected site is within the 1 km stand-off distance or within the predicted downwind vapor hazard area**, all personnel must be in MOPP III or MOPP IV during site set-up. Modification of the MOPP level based on temperature and expected workload during set-up can be accomplished as described in FM 3-4, NBC Protection, Chapter 2, pages 2-5. If the site must be set up in the vapor hazard area, it is critical that the selected site be free of liquid contamination. As long as the team sent to the selected site remains completely outside the predicted liquid hazard area, and optimally outside the stand-off distance, a point chemical survey should take no longer than a few minutes using M8 chemical detector paper.

### **Site Preparation Phase**

The preparation of the site will require time for shuffle pit preparation, dirty dump preparation, and removal of any ground obstacles. If the medical platoon has the luxury of time to accomplish any of this labor-intensive work prior to activating a patient decontamination site, it will greatly increase the accomplishment of the decon mission. If preparation prior to actual use cannot be done, at the very least a ground recon must take place prior to site activation. All vehicle movement routes must be driven, points along the route requiring direction indicators identified, and any ground obstacles identified for removal. The arrival/triage area must be surveyed to ensure it can handle the evacuation vehicles moving into and out of the area, plus the activities of the triage officer and the litter teams. Both the litter decon and ambulatory decon areas must be surveyed to ensure ease of movement by augmentees, medical personnel, and ambulatory patients. The ambulatory decon area must be evaluated for direction indicators that might facilitate easy movement of ambulatory patients through the various steps and likewise for any obstacle that might impede foot traffic. The site must also be evaluated for night operations.

When preparing the site, three shuffle pits need to be prepared, each requiring at least two 50 lb drums of Super Tropical Bleach (STB) each. These pits, depending on the amount of use they get, must be refreshed with the STB once every hour or after ten personnel have shuffled through them. To refresh a shuffle pit, mix half the original ratio of two shovels of STB and three shovels of each back into the pit. For example, if a shuffle pit originally took 30 shovels of STB and 45 shovels of earth to construct, 15 shovels of STB and 22 shovels of earth (the 22.5 was rounded down for safety) would be needed to refresh the pit.

The preparation of the dirty dump is the most labor-intensive effort in the preparation phase. If engineer support is not available (in combat, engineers will have more important missions than digging a hole in the ground at patient decontamination sites), then dedicated engineering tools must be available to assist in digging the dirty dump. Pick axes and long handled shovels are more appropriate than individual entrancing tools.

When setting up in a forest location, it may become necessary to clear low hanging branches, brush, or other ground obstacles. Saws, axes, pry bars, and long handled shovels should be dedicated for this work.

**NOTE:** The dedicated tools mentioned in this section must be obtained prior to deployment and used exclusively by the medical treatment squad for site preparation. This will ensure that tools are available at the critical time.

After site preparation is complete, all tools must be kept on the "clean" side of the hot line.

### **Suggested Equipment Minimums**

During the site set-up, the saying "Do more with less!" should be followed. Only the minimum amount of equipment needed to support patient decon should be set up on the soon to be dirty side of the hot line. Additionally, only the minimum amount of medical supplies needed to support the contaminated emergency treatment point should be set out. During the conduct of decon operations, any resupply items should be obtained from the clean side of the hot line on as needed basis. By keeping equipment and supplies to the barest minimum required, the site OIC/NCOIC will ensure that only minimal items must be dealt with during disestablishment of the decontamination site.

A suggested minimum list of equipment needed to set up a litter decon area and ambulatory decon area is provided below. Most of this equipment is provided in the MES Chem Agent Patient Decontamination.

- **Arrival/Triage Area**

- 1 bk - Field Medical Card (carried by triage officer)
- 2 ea - M291 SDK (carried by triage officer)
- 4 ea - Litters (decontaminable or canvas litters with sacrificial coverings)
- 2 pr - TACTILE chemical protective gloves (1 worn and 1 carried by the triage officer)
- 11 bk - M8 chemical detection paper (1 booklet carried by one member of each litter team and 1 carried by the triage officer)
- 4 ea - Patient Protective Wraps

If organic ambulances are used to transport casualties from collection points that are inside the attack area or hazard area to the patient decontamination site, it is highly unlikely that these same ambulances, which may require decontamination, would be used to evacuate clean casualties to the next echelon of HSS. In this situation, remove from each ambulance the 4 patient protective wrappers (PPW) authorized per vehicle and hold them on the clean side of the hot line. Incoming litter casualties may be placed on these PPWs at the arrival/triage area if the number of litter casualties exceeds the number of available litters. The need to protect the casualty from possible liquid chemical contamination while waiting for a litter is met by using the available PPWs. Also, the PPW will allow transport of the litter casualty within the patient decontamination site, as needed.

- **Emergency Treatment Area**

- 1 bx - M291 SDK
- 6 ea - MARK I, Nerve Agent Antidote Kits
- 6 ea - Atropine autoinjectors
- 4 ea - Convulsant Antidote for Nerve Agent
- 5 ea - 50 ml syringes
- 1 ea - Stethoscope, Adult
- 1 ea - Flashlight
- 2 ea - Field I.V. poles
- 4 ea - I.V. bags
- 6 ea - I.V. sets
- 10 ea - Catheter/needle units
- 1 pg - Providine iodine pads
- 10 ea - Constricting band (one patient use only; impossible to ensure that decon between each patient is complete)
- 2 ro - Adhesive tape (to secure the I.V.)
- 10 ea - Field dressings
- 4 ea - First-aid dressing, 11-3/4"
- 4 ea - 7.25" angled bandage scissors
- 2 ea - Cricothyroidotomy cannula kits
- 2 ea - Airway pharyngeal, LARGE
- 2 ea - Airway pharyngeal, SMALL

- 1 ea - Resuscitator, hand-operated

The resuscitation device, individual chemical (RDIC) would be the best hand-operated resuscitator for use on the dirty side of the hot line. The RDIC can be found in each ground ambulance and in the MES Chemical Agent Patient Treatment.

- **Litter Decontamination Area**

- 4 pr - Litter support stands
- 8 ea - 12 qt utility pails (4 for the clothing removal points and 4 for the skin decontamination points)
- 2 ea - Sponges or rags per 12 qt utility pail
- 2 ea - 7.25" angled bandage scissors
- 1 pr - Chemical protective glove set per augmentee
- 2 pr - TACTILE chemical protective gloves for medics (1 pair is worn, and 1 pair is carried)
- 1 ea - Butyl rubber apron worn by each augmentee working with the litter patients
- 24 ea - "Zip-lock" bags for FMC and personal items from each patient
- 12 ea - Plastic garbage bags
- 1 ea - CAM (if available) to survey suspected contamination or verify completeness of decon; the CAM is kept in the skin decon area)
- 2 ea - M8 chemical detection paper booklets

### ***Litter Patient Decontamination***

### **Dirty Dump**

The dirty dump is located a minimum of 75 yards downwind from the triage and emergency medical treatment areas. Prepare the dump ahead of time; this will be a manual, labor-intensive job if you have no engineering support. The dirty dump initially is a hole 5 feet deep by 4 feet wide by 4 feet long. After closing the decontamination site and back-filling the dirty dump, the location must be reported to higher headquarters as a contaminated site with an eight or ten digit grid coordinate. The report format used to transmit the dirty dump's location is the NBC-4. All personnel working in and around the dirty dump will be at MOPP IV once casualties begin to arrive at the site.

### **Triage Point**

Field ambulances approach the triage point from a downwind direction. Patients are off-loaded from the ambulances and taken to the triage point. Once casualties are inbound, personnel working in the triage area are at MOPP IV. The patients are triaged and visibly marked with prepared tags using the following colors to denote triage casualties:

Immediate - Red

Delayed - Yellow  
Minimal - Green  
Expectant - Black

The use of these colors can extend into night operations with the use of "chem-lights" in the colors mentioned above, with the exception that the "expectant" casualty would be marked with a blue chem-light. **Unmasked patients who arrive at this area must be masked immediately** if wounds do not preclude this. After the arrival of casualties, the entire decontamination site on the downwind side of the hot line must be considered a liquid/vapor hazard area.

Both litter and ambulatory casualties remove, or have removed for them, all military gear (protective mask carrier, kevlar vest and helmet, LBE, weapon, and all types of armament. Search the litter casualty's pockets). After he has been triaged, the casualty will be directed to either the ambulatory decontamination line, litter casualty decontamination line, or the contaminated EMT station.

### **Emergency Medical Treatment (EMT)**

Treatment at the EMT station is limited to the administration of MARK I Kits and diazepam, application of pressure dressings, establishing a patient airway, and starting an I.V. infusion. If immediate clearing of the airway must be done at this point to save a life, the airway is cleared and the mask replaced. After this lifesaving procedure, it may or may not be necessary to change the triage category of the patient to reflect the increased burden of the exposure or the improved condition of the casualty.

The EMT station should be established upwind from the triage point and to the side of the decontamination site perpendicular to the prevailing wind direction. The EMT station should be positioned as far to the side of the decontamination site as is practical. This set-up will allow the EMT station to be away from the heaviest concentration of vapor resulting from the evaporation of liquid chemical agents concentrated at the triage point. **All personnel rendering EMT assistance will be at MOPP Level IV.**

### **Litter Casualty Decontamination**

Personnel working in the litter casualty decontamination areas will be at MOPP Level IV. Only the soldiers performing litter patient decontamination should wear the Toxicological Agent Protective (TAP) apron. It is suggested that all soldiers working in the casualty decontamination areas wear only the Battle Dress Overgarment (BDO). Any additional gear (i.e., helmets and body armor, LBE, protective mask carrier) should be kept on the clean side of the hot line. Each worker should carry in the cargo pockets of the BDO trousers three MARK I Kits, one Diazepam Autoinjector (CANA), one M291 SDK, and one booklet of M8 detection paper.

**NOTE:** Two people will work with each patient, tracking the patient from Step 1 to hand-over at the hot line.

The step-by-step procedure outlined below is the prescribed doctrine for decontaminating a litter patient, but it is by no means the only method. Knowing this method, however, ensures that correct and essential steps are not omitted, and when they are, other measures are taken to preclude a hazardous outcome.

Two different concentrations of chlorine (Cl) solution are used in the patient decontamination procedure. A 0.5% Cl solution is used for all skin decontamination. A 5% Cl solution is used to decontaminate the casualty's protective mask and hood, scissors, TAP aprons, and the gloves of personnel working in patient decontamination area plus litters. Approximately 10 quarts of the chlorine solution are placed in 12-quart stainless steel buckets for use in this area. The buckets should be distinctly marked to distinguish between the two solutions. Preparation of these solutions is covered in Appendix C. Chlorine evaporates quickly at high temperatures, so the solutions should be prepared shortly before they are needed.

### **Step 1. Clothing Removal Point**

1. Decontaminate hood.
  - a. Cover inlet port of filter canister to prevent wetting by the 5% Cl solution.
  - b. Sponge down the voicemitter, eyelets outserts, and sides and top of hood with 5% Cl solution.

**NOTE:** When the 5% Cl solution is not available, use the M291 SDK or the M295.

**NOTE:** After every complete cut, the scissors must be immersed, along with the gloved hands of the soldier doing the cutting, in a 5% Cl solution. While immersed, quickly scrub the cutting edges of the scissors. If the 5% Cl solution is not available, use the M291 or M295 on the scissors and the worker's gloved hands.

2. Remove hood.
  - a. Immerse and scrub scissors in 5% Cl solution
  - b. Cut off hood.
    - (1) Cut zipper cord.
    - (2) Cut neck draw cord.
    - (3) Cut hood shoulder straps.
    - (4) Unzip the hood zipper.
    - (5) Cut the zipper below the voicemitter.
    - (6) Proceed cutting upward toward the inlet valve covers. Cut close to the covers and proceed toward the eyelets outserts.
    - (7) Cut upward to top of eyelets outsert.
    - (8) Cut across forehead to the outer edge of the next eye outsert.
    - (9) Cut downward toward patient's shoulder staying close to the remaining eyelets outsert and inlet valve cover.
    - (10) Cut across the lower part of the voicemitter to the zipper.
    - (11) Immerse and scrub scissors in 5% Cl solution.
    - (12) Cut from the center of the forehead over the top of the head.

(13) Fold left and right sides of the hood to the side of the patient's head, laying the sides on the litter.

3. Decontaminate protective mask/face.

- a. Use 0.5% CI solution, the M291 or the M295.
- b. Cover inlet port of filter canister to prevent wetting by 0.5% CI solution.
- c. Wipe external portions of mask.
- d. Wipe exposed areas of patient's face.
  - (1) Chin
  - (2) Neck
  - (3) Back of ears

**NOTE:** Medic should view the FMC prior to removal.

4. Cut FMC tie wire.

- a. Allow the FMC to fall into a "zip-lock" plastic bag.
- b. Seal the plastic bag and wash with 0.5% CI solution.
- c. Place the plastic bag under the back of head harness straps.

5. Remove personal articles from pockets of BDO.

- a. Place in "zip-lock" bags.
- b. Mark the bags and remove to the contaminated holding area.

6. **Cut casualty's BDO.** Cut overgarment around tourniquets, bandages, and splints. Two people will be cutting the BDO at the same time. Immerse and scrub scissors in 5% CI solution after each complete cut to avoid contaminating inner or under clothing.

- a. Remove BDO jacket by cutting.
  - (1) Unfasten Velcro closure at the wrist and cut from wrist area of sleeves along the inseam of the sleeve up to the armpits, and then to neck area.
  - (2) Repeat cutting procedure for the other side of the jacket.
  - (3) Starting at jacket drawstring, cut the drawstring, unfasten the Velcro closures, moving from waist to neck, and then unzip the jacket.
  - (4) If the casualty is able, instruct him to hold his arms up and away from his body, and drape the left and right chest sections of the jacket over the outside of the litter.
  - (5) Direct the casualty to hold his arms away from his upper body until told otherwise.
  - (6) If the casualty is unable to perform this instruction, one augmentee will hold the casualty's gloved hand and perform this action. Another augmentee folds the chest sections over the outside of the litter.
- b. Remove the BDO trousers by cutting.
  - (1) Cut the leg closure cord at the cuff.
  - (2) Cut along the inseam of the left trouser leg until the crotch area is reached, then cut across into the zipper.
  - (3) Cut along the inseam of the right trouser leg until the crotch area is reached, then go sideways into the first cut.
  - (4) Unsnap the trouser waistband and unzip the trousers.

- (5) Allow trouser halves to drape over the side of the litter.
- (6) Tuck the remaining cloth between the legs ensuring that only the black BDO lining is showing.

- 7. **Remove outer gloves.** Do not remove the inner gloves.
  - a. Decontaminate the casualty's gloves with 5% CI solution.
  - b. Instruct the casualty to hold his arms away from the litter and upper body or, if he cannot comply with instructions, hold his gloves by the fingers.

**NOTE:** Always remove the gloves over the sides of the litter.

- c. Grasp the cuff of the glove.
  - d. Pull the cuff over the fingers, turning the glove inside out.
  - e. Tell the casualty to carefully lower his arm(s) across the chest after the glove(s) is removed. If the casualty is unable to do this, decontaminate your chemical gloves and do it for him.

**CAUTION:** Do not allow the arms to contact the exterior (camouflage) side of the overgarment.

- f. Dispose of the contaminated gloves by placing them in a trash bag.
  - g. Immerse and scrub your own gloves in 5% CI solution.

- 8. **Remove black vinyl overboots (BVO).**
  - a. Unfasten the three elastic closures.
  - b. Gently pull the BVO by the heel until it is removed.
  - c. If the BVO will not come off, cut the boot from top to bottom along the center line of the boot. Fold the BVO down and gently pull the heel until it is removed.

9. **Remove personal effects from BDU.**
  - a. Place personal effects in "zip lock" plastic bag.
  - b. Remove the bag to the contaminated holding area.
10. **Remove combat boots without touching body surfaces.**
  - a. Cut the bootlaces along the tongue.
  - b. Pull the boots downward and toward you until removed.
  - c. Place the boots in the plastic bag containing the chemical overboots and gloves.
11. **Remove inner clothing.**
  - a. Cut or unbuckle belt.
  - b. Cut the BDU pants following the same procedures as for the overgarment trousers.
  - c. Cut the BDU jacket following the same procedures as for the overgarment jacket.
12. **Remove undergarments** following the same procedure as for fatigues. If the patient is wearing a brassiere, cut it between the cups. Both shoulder straps are cut where they attach to the cups and are laid back off the shoulders. Place the undergarments into the plastic garbage bag containing the other contaminated items.
13. **Remove socks.** Place in the plastic garbage bag.
14. **Remove inner gloves.** Place in the plastic garbage bag.

**NOTE:** Waste material from two litter patients should be placed into one 35 gallon trash bag along with the used 5% and 0.5% CI solutions used on the two patients. The bag must be tied shut and transported to the dirty dump.
15. **Workers** should decontaminate their own TAP aprons, gloves, and lower portion of protective hood in 5% CI solution.

A three-man patient lift is now used to remove the nude patient from the contaminated clothing removal litter to the clean skin decontamination litter. The three workers lifting the patient slide their clean arms under the patient in forklift fashion supporting the casualty's neck, torso/lower back, and distal legs using the straight back knee-lift technique. After the casualty is lifted up, he is rolled slightly inward against the lifters' chests to make holding the casualty up less of an effort. Before and during the lift, the leader explains to the casualty exactly what is going to happen. The dirty litter and its content of clothing are removed from under the casualty, and a clean decontaminable litter, if available, is placed under the patient. If decontaminable litters are not available, use a plastic covered canvas litter (or, less desirable, a single use of an uncovered canvas litter). The cut BDU, BDU, and undergarments are now placed in the plastic garbage bag with the other waste from the casualty. The patient is then carefully laid back on the stretcher. The dirty litter must be decontaminated with 5% CI solution and reused only for transfer of casualties from the triage area to the clothing removal point.

## Step 2. Skin and Wound Decontamination

The casualty is now spot decontaminated with the M258A1/M291 SDK only at points that could be potentially contaminated (i.e., tears or holes in the BDO, the neck and lower face, wrists, etc.).

An alternate method is to decontaminate the entire skin surface by lightly wiping the skin with a sponge and **0.5% CI solution**. The casualty is washed from the midline outward, constantly washing from clean to dirty and not placing a dirty sponge back on a clean area without first rinsing it in the 0.5% CI solution. The complete topside of the casualty is washed in this manner, paying particular attention to hairy areas of the body (groin and axillary regions) and sweaty areas (belt-line, just above the boots, the crease of the buttocks, and wrists). The back side of the casualty will be washed after he is log-rolled onto his side. The casualty's back is washed from the shoulders to over halfway down the backside, taking care not to miss any areas. The upper side of the litter is decontaminated prior to laying the casualty down again. The opposite side of the casualty is washed in exactly the same manner, and the litter is decontaminated again. After the casualty is decontaminated, the medic removes dressings and replaces them only if needed.

Superficial wounds (**not** body cavities, eyes, or nervous tissue) are flushed with 0.5% CI solution, and new dressings are applied if needed. Cover massive wounds with plastic. The medic places new tourniquets 0.5 to 1 inch proximal to the original tourniquet and removes the old ones. Splints are not removed, but are saturated to the skin with 0.5% CI solution. If the splint cannot be saturated (air splint or canvas splint), it must be removed sufficiently to enable everything under it to be saturated with the 0.5% CI solution.

## Step 3. Monitor for Completeness of Decontamination

The CAM should be used for this step. If it is not available, M8 or M9 paper may be used instead, although the ability of the papers to detect any agent at this point is highly unlikely. Once the casualty is confirmed clean of any active chemical agent residue, he is carried to the hot line using the three-man patient carry. Prior to transfer of the casualty, the dirty team washes their TAP aprons, gloves, and lower part of the protective hood with the 5% CI solution. The team members should wash each other, with each member being decontaminated standing with his arms spread out to the sides, allowing the team member performing the decontamination to get into all the folds of the TAP apron.

**NOTE:** Immediately after the dirty team has handed off the patient, they move to the litter decon point and assist in any decontamination that has not been accomplished by other augmentees.

**NOTE:** Straddling the hot line is the casualty pass-over point, which is in a shuffle pit. The shuffle pit is composed of two parts Super Tropical Bleach (STB) and three

parts earth (by volume). The shuffle pit should be deep enough to cover the bottom of the protective overboots and large enough that the dirty team, two litter stands supporting a clean litter, and the clean team can occupy it at one time.

### **Clean Side Actions**

**NOTE:** As the dirty team prepares to bring the casualty to the hot line, the clean team opens a blanket or other covering appropriate for the environmental conditions.

1. The dirty team brings the decontaminated casualty to the hot line on the litter and places the litter on the stands. Three dirty team members log-roll the casualty up and off the litter. A fourth dirty team member removes the litter. The clean team replaces the litter. The dirty team lowers the casualty onto the clean litter and moves away.

2. After the dirty team moves away, the blanket is folded over the casualty, and the casualty is moved from the pass-over point to a holding area 30 to 50 meters upwind.

3. In the **clean treatment area**, the patient can now be retriaged, treated, and evacuated. In a hot climate, the patient will probably be significantly dehydrated, the rehydration process must begin immediately. Overhead cover should be provided for casualties in the holding area.

### **Logistical Support Point**

Of equal importance to the casualty decontamination effort is the logistical support of the ongoing operation. A logistics support point should be established upwind between 30 to 50 meters of the hot line. At this point, the CI solutions are prepared and 1 or 2 quart canteens are also stockpiled for use by all the soldiers manning the site. The logistics support point should have one 400 gallon water buffalo or initially, twenty 5 gallon water cans. Medical supplies, chemical casualty treatment, and decontamination MESs can be located at this point along with additional decontamination supplies.

### **Rest/Rehydration Point**

A point should be established 50 meters perpendicular to the litter casualty decontamination line and approximately 5 meters from the hot line for workers to use as a rest and rehydration point. Prior to using this point, workers must decontaminate the TAP aprons they are wearing using a 5% CI solution and doff the apron near the decontamination line. Next, they must decontaminate the chemical protective boots and gloves using a wet or dry mix of Super Tropical Bleach (STB), and using the M295 SDK or the M291 SDK, decontaminate the protective hood. After completion of this decontamination process, the soldiers move to the rest/rehydration point. The CAM should be used to monitor the boots, lower leg area of the BDO, gloves, and lower sleeve area of the BDO, and finally, the hood. If all indications are that these areas are vapor free, then the soldiers conduct an unmasking exercise and begin to rehydrate. The soldiers should not group together, but should maintain three meters distance from one another. If possible, this rest point should have overhead cover for shade.

## ***Ambulatory Casualty Decontamination***

Decontamination of ambulatory casualties closely follows the method described in FM 3-5, NBC Decontamination, Chapter 9, under "Patient Decontamination" with a few differences: (a) gear drop is done at the triage area, (b) the hood is removed by cutting during casualty decontamination, (c) there is medical attention during the decontamination process for casualties, (d) the order of removal of the boots and trousers is different in the two procedures, and (e) spot decontamination of the BDU may be done with the ambulatory casualty as long as the chemical contamination is confined to a small area.

**NOTE:** An augmentee must be stationed at the hood and protective mask decontamination station to perform the decontamination and cutting, if necessary. This action is conducted in a shuffle pit using two parts STB mixed with three parts earth (by volume). The shuffle pit should be large enough for two casualties to stand in and deep enough to cover the overboots.

### **1. Decontaminate and remove the hood.**

- a. Cover inlet port of canister filter to prevent wetting by the 5% CI solution.
- b. Sponge down the front, sides, and top of the hood with 5% CI solution.
- c. Cut the underarm straps and the neck draw cord, and unzip the zipper.
- d. Remove the hood by cutting or, with the quick doff hood or similar hoods, by loosening the hood from the mask attachment points.
- e. Remove the FMC and place it in a plastic bag. Decontaminate the bag with 0.5% CI solution and place it under the protective mask harness.

**NOTE:** After completing the hood removal, the casualty is instructed to move to the next step, which should be 10 to 20 meters upwind from the hood removal station.

**2. Remove personal effects from BDO.** Have the casualty remove all items from the BDO jacket and trousers and place them in a "zip-lock" bag. The bag is marked and moved to the contaminated holding area.

### **3. Remove BDO jacket.**

- a. Stand in front of the casualty.
- b. Cut or untie the BDO jacket drawstring.
- c. Unfasten the BDO jacket velcro closures starting at the bottom.
- d. Unzip the BDO jacket front.
- e. Move to the rear of the casualty.
- f. Unfasten the velcro wrist closures.
- g. Unfasten the three snaps on the BDO jacket.
- h. Instruct the casualty to do the following, if able:
  - (1) Clench fists.
  - (2) Stand with arms held straight down.

- (3) Extend arms backward at about a 30 degree angle.
- (4) Place feet shoulder width apart.
- i. Grasp the jacket collar at the sides of the neck.
- j. Peel jacket off the shoulders in a down and away motion, smoothly pulling the jacket inside out over the casualty's fists.
- k. Place the BDO jacket in a plastic trash bag.

**NOTE:** Cut the BDO jacket to aid removal if necessary.

**4. Remove Butyl Rubber Gloves.**

- a. Augmentee washes gloved hands in 5% CI solution.
- b. Use thumbs and forefingers of both hands.
- c. Grasp the heel of the casualty's glove at the top and bottom of the forearm.
- d. Peel the glove off inside out with a smooth motion.
- e. Place the gloves in a plastic trash bag.

**5. Remove glove inner liners.** The patient should remove the liners to reduce the possibility of spreading contamination. The augmentee instructs the casualty to remove the white glove inner liner using the following guidance:

- a. Grasp heel of glove liner without touching exposed skin.
- b. Peel liner downward and off.
- c. Drop it into the plastic trash bag.
- d. Remove the remaining liner in the same manner.
- e. Drop it into the plastic trash bag.

**6. Remove casualty's black vinyl overboots (BVO).**

**NOTE:** Follow the same instructions for removing the BVO worn by a litter casualty.

**7. Remove BDO trouser.**

- a. In order, unfasten or cut both trouser cuff draw cords, unsnap the outer button, loosen the two waist adjustable tabs over the hips, unzip the trousers, and unfasten the inner snap.
- b. Grasp trousers at the waist.
- c. Peel trousers down over the casualty's overboots.
- d. Cut the trousers to aid removal if necessary using the following procedure:
  - (1) Cut around all bandages and tourniquets first.
  - (2) Cut up the front of both trouser legs to the waist. Prior to the final cut on the trouser leg, grasp the BDO material at the buttocks area, and as the final cut is made, pull the trousers off toward the rear.
- e. Place the BDO trousers into the plastic trash bag.

**NOTE:** After completing BDO removal, the casualty is instructed to move 10 to 30 meters to the liquid contamination control line.

8. **Remove personal effects from BDU.** Have the casualty remove all items from his BDU and deposit them into a "zip-lock" bag. The bag is moved to the contaminated holding area. Have the casualty move 10 meters upwind to the monitoring point.

9. **Monitor BDU.**

- a. Monitor with CAM or M8 detection paper.
- b. Check all areas of the casualty's clothing and combat boots.
- c. Pay particular attention to:
  - Hair and neck area
  - Discolored areas
  - Damp spots
  - Wrist closure area
  - Areas under tears in BDO
  - Around dressings
- d. If clean, send the casualty to the hot line.
- e. If contaminated, complete the following.

10. **Spot Decon.** Remove spots by using the 0.5% CI solution, pads from the M291 Kit, or M295 Kit, or by cutting away the contaminated area. Always dip and scrub the scissors after each complete cut. Recheck the area with the CAM or the M8 detection paper.

11. **Remove bandages and tourniquets (this procedure is done by a medic).**

- a. Place new tourniquets 1/2 to 1 inch above the old tourniquets.
- b. Remove old tourniquets.
- c. Decontaminate the exposed skin area.
- d. Cut away bandages.
- e. Decontaminate the exposed skin area.
- f. Replace bandages only to control bleeding.
- g. Decontaminate exposed skin.

12. Conduct final check for completeness of decontamination with the CAM or M8 detection paper.

13. The augmentee instructs the casualty to move across the hot line through a shuffle pit to the patient holding area.

### Disestablish the Patient Decontamination Station

The closure of the patient decontamination site will pose as difficult a mission as the actual decontamination effort itself, due in large part to the physical condition of the medical personnel and the nonmedical augmentees. The disestablishment of the site

must be accomplished carefully to prevent additional casualties from the augmentees and medical personnel. Fatigue will cause site personnel to move slower and make mistakes. Regardless of the number of times command drinking was accomplished, most of the site personnel will be dehydrated. Dehydration will lower performance and stamina while increasing the likelihood of heat injuries. Prolonged encapsulation in the MOPP gear may distort tempers, attitudes, and motivation. Any plans made to disestablish the decon site must be simple and quick; personnel will not be able to sustain an involved and detailed process.

The three areas of concern during closure are equipment recovery, site closure, and personnel recovery. A prioritization of effort must be established to optimize the recovery of essential equipment versus expendable equipment to deny threat forces tactical intelligence and ensure that site personnel are able to complete required work and get out of total encapsulation as quickly and safely as possible.

### **Equipment Recovery/Site Closure**

A list of recommended equipment for recovery is provided below. These items can be recovered by decontamination with a slurry mix of STB or a 5% CI solution.

To prepare the STB slurry mix, use four parts STB mixed into six parts water (by weight). For example, 6 parts of water weighs 42 lbs (1 gallon = 7 pounds) and mixed with 28 pounds of STB, gives you the required slurry mixture. The slurry mixture or 5% CI solution must be scrubbed onto the items requiring decontamination and allowed to remain on the surface for 30 minutes. After this contact time, the items must be flushed with clean water.

- Decontaminable litters
- Litter support stands
- 12-quart utility pails
- Butyl rubber aprons
- Field I.V. poles
- Flashlight
- Resuscitation Device Individual Chemical (RDIC)
- Chemical Agent Monitor (CAM) (if available)

Decontamination and monitoring of the equipment can take place adjacent to the hot line and 50 meters to the left or right of the litter/ambulatory decontamination area. After the 30-minute contact time has elapsed and all items have been flushed with clean water, each item must be monitored with the CAM before it is passed over the hot line. When monitoring with the CAM, ensure that cracks, joints/seams, bolts, porous materials, and any openings are monitored, in addition to surface areas of the equipment items.

While waiting for the 30-minute contact time to elapse, all other items on the dirty side of the hot line can be placed in a plastic garbage bag and put in the dirty dump.

Each shuffle pit needs to be camouflaged with dirt or other available materials. Several personnel must conduct a police call of the litter decon area, ambulatory decon area, and arrival/triage area. These final actions are designed to deny threat forces any tactical intelligence on the effect their C/B weapon had on our forces. Any direction indicators for vehicles or personnel must be taken down and placed in the dirty dump.

### **Personnel Recovery**

Upon completion of equipment recovery/site closure, all personnel except for two will conduct MOPP gear exchange. The site NCOIC/OIC will select a position adjacent to the hot line and 50 meters opposite the side used to decontaminate equipment. All personnel will perform MOPP gear exchange with the unit supplying required support. After completing MOPP gear exchange, the two remaining personnel will put all discarded MOPP gear into plastic bags and place them in the dirty dump. Additionally, they will backfill the dirty dump, camouflage it as much as possible, and mask the contaminated area with the NATO NBC marking set. They will then move back to the hot line and perform MOPP gear exchange. The remaining two sets of discarded MOPP gear are left in place and camouflaged.

**NOTE:** It is strongly suggested that two personnel from the clean side of the hot line are detailed to complete the actions outlined above.

## Chemical Defense Equipment

This overview is divided into four sections:

- Individual Protection
- Individual Decontamination
- Detection and Alarms
- Patient Protective Equipment

### INDIVIDUAL PROTECTION

This section includes standard "A" chemical defense equipment (CDE) issued to each soldier depending on their MOS and consisting of the following:

- M40 Series Field Protective Mask
- M42A2 Combat Vehicle Protective Mask
- M48 Chem-Bio Aircraft Mask
- M45 Air Crew Chem-Bio Mask System
- Battle Dress Overgarment
- Chemical Protective Gloves and Overboots

#### **Chemical-Biological Mask: Field M40**

4240-01-258-0061 - Small  
4240-01-258-0062 - Medium  
4240-01-258-0063 - Large

#### **Chemical-Biological Mask: Combat Vehicle M42A2**

4240-01-258-0064 - Small  
4240-01-258-0065 - Medium  
4240-01-258-0066 - Large

TM 3-4240-300-10  
TM 3-4240-300-20&P

When properly fitted and worn, each of these masks will protect the wearer's face, eyes, and respiratory tract from field concentrations of all known chemical, biological, and riot-control agents. The CB hood (4240-01-260-8723) affords additional protection for the head, neck, and shoulders.

Because both the M40 and M42 masks have drinking tubes positioned around the outlet valve assembly, it is possible to drink water in a chemically contaminated environment. First, the soldier must use M8 paper to verify that the M-1 canteen cap is

not contaminated before attaching the drinking tube to the cap. Soldiers operating armored vehicles will thus be able to drink water in a contaminated environment.

The M17 optical insert (6540-01-060-0611), which has a wire frame, is the only approved optical insert for use with the M40 series and M42A2 masks for personnel requiring visual correction.

Innovations in these masks include the following:

- Each mask is molded with two voicemitters, one in the front of the mask and one over the cheek. The cheek voicemitter allows the use of the radiotelephone handset without any interference from the protective mask and is interchangeable with the cheek filter canister.
- Each mask uses a NATO standard external filter canister (4240-01-119-2315) of the same type used by Germany and England. The unit nuclear/biological/chemical (NBC) noncommissioned officer (NCO) may position the canister either on the soldier's right cheek or on his left cheek to allow him to fire the M16A2 rifle from his left or right shoulder, respectively.
- Each protective mask is molded in silicone rubber to allow easy fitting of all wearers, including those who require an extra small M17A2 mask.
- Each mask is made with an in-turned-sealing surface around the entire inner edge of the mask. This allows for a more comfortable seal on the soldier's face.
- The eye lenses in each of these masks are 35% larger than the M17A2 mask eye lens and permit greater range of vision.

### **M45 Aircrew Chemical-Biological Mask System**

The M45 Aircrew Chemical-Biological Mask was developed to protect aircrew personnel against all known chemical and biological agents and radiological particulates. It provides a microphone pass-through for aircraft communications, a drink tube pass-through for liquid nutrients, close-fitting eye lenses, front and side voicemitters for face-to-face and phone communications, low-profile canister interoperability hose assembly for both hose and face-mounted configurations, and interchangeable nose-cups mounted in a silicone rubber facepiece with an in-turned peripheral seal. The M45 Aircrew Mask provides respiratory, eye, and face protection. It replaces the Army's M24 and M49 Mask System. The mask provides the required chemical and biological protection without the aid of forced-ventilation air, while maintaining compatibility with rotary-wing aircraft sighting systems and night vision devices.

### **M48 Chemical-Biological Aircraft Mask**

The M48 Chemical-Biological Aircraft Mask was developed for the AH-64 Apache helicopter aviators and provides face, eye, and respiratory protection against chemical-biological agents and radioactive particles. The M48 was designed for compatibility with the Integrated Helmet and Display Sighting System and the Optical Relay Tube,

subsystems of the Apache. The M48 mask has a lightweight motor blower that can be mounted on the user. The motor blower provides filtered, breathable air that keeps the head cool and prevents the eye lens from fogging. While wearing the M48 mask, crew members can perform their mission in a NBC environment inside or outside of the aircraft.

The M48 mask has a form-fitting facepiece with lenses mounted close to the eyes; an integrally-attached CB hood and skull-type suspension system; an inhalation air distribution assembly for regulating the flow of air to the facepiece and hood; a valve assembly that maintains overpressure in the mask and hood; an electronic microphone; and a portable, battery-powered motor blower filter assembly. The M48 is a product improvement of the M43 mask, which is currently used by the Apache crew; this product improvement incorporated user-requested features. The blower does not require an aircraft mounting bracket and can operate continuously for eight hours on a single, standard issue battery. The M48 will replace the M43 mask and will only be worn by Apache Helicopter Aviators.

**Key features include:**

- Pilot-mounted motor blower; no aircraft modification required
- Standard U.S. Army battery
- Improved NBC survivability
- 69% weight reduction over the currently fielded motor blower with battery

**Battle Dress Overgarment (BDO)**

8415-01-137-1700: XXX-Small

8415-01-137-1701: XX-Small

8415-01-137-1702: X-Small

8415-01-137-1703: Small

8415-01-137-1704: Medium

8415-01-137-1705: Large

8415-01-137-1706: X-Large

8415-01-137-1707: XX-Large

**Desert Battle Dress Overgarment (DBDO)**

**6-Color**

8415-01-324-3084: XXX-Small

8415-01-324-3085: XX-Small

8415-01-324-3086: X-Small

8415-01-324-3097: Small

8415-01-324-3088: Medium

8415-01-324-3089: Large

8415-01-324-3090: X-Large

8415-01-324-3091: XX-Large

## **Desert Battle Dress Overgarment (DBDO)**

### **3-Color**

8415-01-327-5346: XXX-Small

8415-01-327-5347: XX-Small

8415-01-327-5348: X-Small

8415-01-327-5349: Small

8415-01-327-5350: Medium

8415-01-327-5351: Large

8415-01-327-5352: X-Large

8415-01-327-5353: XX-Large

The BDO and DBDO have been designed with new features that increase protection in a chemical environment and make wearing the suit less of a heat burden. The suit has more activated charcoal than the previous model, a novel outer cloth weave, and an outer cloth "scotchguard" type treatment resistant to liquid chemical agents. Because of the increased amount of charcoal, the BDO and DBDO can now be worn in an uncontaminated environment for 30 days following removal of the garment from its vapor-protective bag. This wear time may be extended past 30 days at the discretion of the unit commander. The suit may be worn for 24 hours in a contaminated area. Once the suit has been contaminated, the soldier must replace the suit by using the MOPP gear exchange procedure described in STP 21-1-SMCT, Soldier's Manual of Common Tasks, October 1990, Task #031-503-1023, Exchange MOPP Gear. The discarded BDO must be incinerated or buried.

The BDO and DBDO are presently produced in both woodland and desert camouflage patterns. The suits have large butyl rubber patches sewn into the elbows and knees to prevent liquid chemical agents from penetrating the suit in these areas.

The BDO and DBDO add approximately 11 pounds to the soldier's weight. In addition, the BDO prevents heat exchange with the environment and may add, depending on the soldier's level of exertion, 10°F to 15°F to his ambient temperature and heat burden. When wearing the BDO or DBDO at MOPP 1 or MOPP 2 and complete encapsulation is not required, certain modifications to the uniform are authorized:

- The trouser leg closures may be unzipped.
- The waist tabs may be loosened.
- The jacket may be unzipped.
- The sleeve Velcro closures may be opened.

This overall loosening of the BDO/DBDO will allow heat to escape as walking and other movements induce a bellows action of the suit against underlying clothing and skin. Because of the weight of the BDO/DBDO, field suspenders (8440-00-221-0852) should be used to allow support of the trousers and as much comfort as possible.

**Chemical Protective Gloves and Overboots**  
**Gloves, 0.025-inch thickness**

8415-01-144-1862 - X-Small  
8415-01-033-3517 - Small  
8415-01-033-3518 - Medium  
8415-01-033-3519 - Large  
8415-01-033-3520 - X-Large

**Gloves, 0.014-inch thickness**

8415-01-138-2497 - Small  
8415-01-138-2498 - Medium  
8415-01-138-2499 - Large  
8415-01-138-2500 - X-Large

**Gloves, Tactile 0.007-inch thickness**

8415-01-138-2501 - Small  
8415-01-138-2502 - Medium  
8415-01-138-2503 - Large  
8415-01-138-2504 - X-Large

**Black Vinyl Overboots (BVO)**

8430-01-048-6305 - Size 3  
8430-01-048-6306 - Size 4  
8430-01-049-0878 - Size 5  
8430-01-049-0879 - Size 6  
8430-01-049-0880 - Size 7  
8430-01-049-0881 – Size 8  
8430-01-049-0882 - Size 9  
8430-01-049-0883 Size 10  
8430-01-049-0884- Size 11  
8430-01-049-0885 - Size 12  
8430-01-049-0886 - Size 13  
8430-01-049-0887 – Size 14

The chemical protective gloves are made from butyl rubber and are impermeable to chemical agents. The BVO is made from vinyl that will protect the soldier against NBC agents and environmental effects. Both may also be decontaminated and reissued. Both the 0.025-inch thick and 0.014-inch thick gloves and BVO boots, when worn with the leather combat boot, can be used for 24 hours in a contaminated environment. After a complete visual inspection and decontamination with a 5% CI solution, they may be worn again. The 0.007-inch thick **tactile** gloves must be inspected and decontaminated with the 5% HTH solution within 6 hours after being in a contaminated environment.

Once decontaminated, the 0.007-inch thick **tactile** gloves may be re-used. In an uncontaminated environment, the gloves and boots can be used for 14 days, and if found to be serviceable after a thorough inspection, can be used for 14 days more. When working with petroleum products, care must be taken not to allow these products to contact the boots and gloves. Should petroleum products contaminate the boots and gloves, wipe off and air-dry the boots or gloves within two minutes. If this cannot happen within two minutes, new boots or gloves must be obtained immediately.

The gloves and the boots pose safety hazards. The 0.025 inch thick and 0.014 inch thick gloves degrade tactile ability and in a cold environment will not provide adequate protection against cold injury. The 0.007-inch thick gloves have been produced to answer the need for **selected** personnel to have excellent tactile ability while wearing these gloves, but offer no protection from cold. These thin gloves must be issued along with the 0.025-inch thick gloves and worn only while performing those tasks requiring good tactile use of the hands and fingers.

For further information on these items, see FM 3-4, NBC Protection, 29 May 1992, Chapter 1. Individual Protective Equipment.

## INDIVIDUAL DECONTAMINATION

The preceding section provided an overview of the primary items of chemical defense equipment which, when used correctly, will prevent contact with agent in typical battlefield concentrations. The problem of decontamination arises when some soldiers, because of bad training, bad discipline, or bad luck, become exposed to liquid agent despite the availability of protective masks and clothing.

This section addresses the two skin decontamination kits and the equipment decontamination kit currently in the inventory.

The kits are fairly simple in design and function, and instructions for their use are straightforward and easily committed to memory. Because of the potency of liquid nerve agents and the rapidly occurring tissue damage caused by vesicants, every soldier must be able to conduct an effective decontamination of all exposed skin automatically and without referring to the instructions printed on the kits.

The kits are as follows:

- Decontamination Kit, Skin: M291
- Decontamination Kit, Individual Equipment, M295

### **Decontaminating Kit, Skin: M291**

4230-01-276-1905

TM 3-4230-229-10

The introduction of this kit marks a new approach to skin decontamination. The M291 Kit consists of six identical packets, each containing a mixture of activated resins. This resin mixture both adsorbs liquid chemical agents present on the soldier's skin and neutralizes agents. The mixture consists of an adsorbent resin, a resin containing sulfonic acid, and a hydroxylamine-containing resin. After masking, the soldier opens any packet from the kit, removes the applicator pad, and applies an even coating of resin powder while scrubbing the entire skin area suspected to be contaminated. One applicator pad will decontaminate both hands and the face, if necessary. If the face must be decontaminated, then the neck (including the throat area) and the ears must also be decontaminated using a second applicator pad.

The black resin powder residue will provide a visual confirmation of the thoroughness of application and will not cause any skin irritation, even after prolonged contact with skin. However, normal precautions must be observed so that the powder does not enter open wounds, the mouth, or the eyes. This kit will also be used for training; no training aid will be produced. The issue is 20 M291 Skin Decon Kits per box.

#### **Decontamination Kit, Individual Equipment: M295 (DKIE)**

4230-01-357-8456

TM 3-4230-235-10

The M295 DKIE allows for the decontamination of individual equipment through physical removal and absorption of chemical agent with no long-term, harmful side effects. The kit consists of a carrying pouch containing four individual decon packets, enough to do two complete individual equipment decontaminations. Each packet contains a mitt filled with the same decon powder used in the M291SDK. Two packets will decontaminate the protective gloves, M16A2 rifle, chemical protective helmet cover, protective mask hood, load carrying equipment (LCE) and accessories, mask carrying case, and protective boots.

The decon mitt will only remove surface liquid contamination. The equipment that has been decontaminated can still pose a vapor hazard due to absorbed liquid chemical agent desorbing as a vapor.

The M295 DKIE will be issued to the squad at its lowest point of issue. The M295 DKIE is packaged in a "squad box" with 80 kits in each box. The squad members should be given at least one kit. The packets for one complete decontamination can be carried in the cargo pocket of the BDO trouser.

As with the M291 SDK, the M295 DKIE will be used for both training and combat.

## **DETECTION AND ALARMS**

This section will describe the equipment issued for detection and identification of chemical agent liquid and vapor in the environment. For both the individual soldier and

the unit, these items of equipment (listed below) are the primary means of identifying the presence and type of chemicals on the battlefield and determining when a safe condition exists.

- Paper, CM Agent Detector: M8
- Paper, CM Agent Detector: M9
- Chemical Agent Detector Kit: M256A1
- Chemical Agent Monitor
- Automatic Chemical Agent Alarm: M8A1
- Water Test Kit, Chemical Agents: M272

### **Paper, CM Agent Detector: M8**

6665-00-050-8529

The M8 detector paper is the only means of identifying the type of chemical agent present in liquid form on the battlefield. Each soldier carries one booklet of M8 paper in the interior pocket of the protective mask carrier. A soldier encountering an unknown liquid suspected of being a chemical agent must don and check his mask within nine seconds and quickly don the attached hood, alert others in the vicinity, and then proceed to put on all of his chemical protective clothing. He then removes the booklet of M8 paper from his mask carrier, tears a half sheet from the booklet, and, if possible, affixes the sheet to a stick. Using the stick as a handle, the soldier then blots the paper onto the unknown liquid and waits for 30 seconds for a color change. The resulting color is then compared to the colors on the inside of the front cover of the booklet to identify the type of liquid agent encountered.

- G: Nonpersistent Nerve: Yellow
- H: Blister: Red
- V: Persistent Nerve: Olive Green or Black

False positive can occur if liquid insecticides are on the surface being tested. Antifreeze and petroleum products will also cause false positive readings.

### **Paper, CM Agent Detector: M9**

6665-01-049-8982

TM 3-4230-229-10

The M9 detector paper detects the presence of liquid chemical agent, but does not identify either the specific agent or the type of agent encountered. Each soldier carries one 30-feet long and 2-inch wide roll of M9 paper with adhesive backing to facilitate wrapping a strip of the paper around a sleeve and a trouser leg of the BDO. (Because the indicator dye in the paper is a potential carcinogen, gloves should be worn during application, and the paper should not contact the skin.) The paper is a dull, off-white or cream color in the absence of liquid agent but contains an indicator chemical that, when dissolved in liquid agent, turns a reddish color. When the soldier sees this color change, he must immediately mask, alert others, and if there is any possibility of skin exposure, proceed immediately with skin decontamination.

The M9 paper will detect nerve agent or blister agent droplets as small as 100 microns in diameter. False positive may be seen if the paper is exposed to antifreeze, liquid insecticide, or petroleum products. The soldier's attention to possible interfering substances on the battlefield can help in the later interpretation of a color change in the M9 paper in the absence of confirmation tests for agents. This does not relieve him of the obligation to mask and take other appropriate measures immediately after seeing a color change in the detector paper.

### **Chemical Agent Detector Kit: M256A1**

6665-01-133-4964

TM 3-6665-307-10

The M256A1 Chemical Agent Detection Kit is designed to detect and identify chemical agents in liquid or vapor and consists of the following:

- a booklet of M8 paper (previously described) to detect agents in liquid form and
- 12 foil-wrapped detector tickets containing eel enzymes as reagents to detect very low concentrations of chemical vapors.

Instructions for the use of the detector tickets appear on the outside of each of the foil packets and in a separate instruction booklet in the kit. The following chart shows the agents detected by the M256A1 Kit:

<b>Agent Detected</b>	<b>Symbol</b>	<b>Class</b>
Hydrogen Cyanide	AC	"Blood" (cyanide)
Cyanogen Chloride	CK	"Blood" (cyanide)
Mustard	H	Blister
Nitrogen Mustard	HN	Blister
Distilled Mustard	HD	Blister
Phosgene Oxime	CX	Blister
Lewisite	L	Blister
Nerve Agents	V and G Series	Nerve

By following the directions on the foil packets or in the instruction booklet, a soldier can conduct a complete test with the liquid-sensitive M8 paper and the vapor-sensitive detector ticket in approximately 20 minutes. During the test, the sampler must be kept out of direct sunlight, which speeds evaporation of the reagents. Waving the detector sampler in the air also accelerates evaporation, so the sampler should be held stationary during all parts of the test.

**Simulator, Detector Tickets,**  
**Chemical Agents: Training, M256A1**

6665-01-112-1644

TM 3-6665-320-10

The M256 trainer simulator was developed to provide realistic training while avoiding unnecessary exposure to potentially carcinogenic reagents in the M256A1 detector kit. The M256 trainer contains 36 pre-engineered detector tickets and an instruction booklet. The pre-engineered detector tickets show color changes comparable to those seen when the M256A1 detector kit is used in clean or contaminated environments. Each training aid detector ticket has a specific code printed on the outside of the foil package. A list of codes is also printed on the inside of the training aid box under the lid, and instructions for the use of the simulator are also included. The codes are shown below.

MARK	SIMULATED TEST FOR
T-400	SAFE, "ALL CLEAR" - No NERVE, BLISTER, or BLOOD agents
T-401	DANGER - NERVE: G agents or VX
T-402	DANGER - BLISTER: HD (sulfur mustard)
T-403	DANGER - BLISTER: CX (phosgene oxime)
T-404	DANGER - BLOOD: AC (hydrogen cyanide) or CK (cyanogen chloride). (STRONG RXN indicates AC or CK in HIGH CONC)
T-404A	DANGER - BLOOD: AC (hydrogen cyanide) or CK (cyanogen chloride). (WEAK RXN indicates AC or CK in LOW CONC)

**Chemical Agent Monitor (CAM)**

6665-01-199-4153

TM 3-6665-331-12&P

The CAM, which is used to detect nerve and blister agents as vapors only, uses a 10-mCi nickel-63 ( $\text{Ni}^{63}$ ) beta-particle radiation source to ionize airborne agent molecules that have been drawn into the unit by a pump. The resulting ion clusters vary in mass and charge and thus also travel at different rates in an applied electrical field. Comparison of the mobilities of the different ionic species to electronically stored standards allows an on-board microcomputer to determine the type of agent and its relative concentration. A liquid crystal display (LCD) presents these data as a series of concentration-dependent bars in a G mode for G agents and VX and in an H mode for blister agents.

The CAM detects agent vapor in that volume of air drawn by the pump into the sampling chamber of the instrument. It follows that the inlet port must not come into contact with a suspected area of evaporating agent on a surface but must nevertheless

approach within a few inches of the site of suspected contamination. Because of the variation in agent concentration from one spot to another, depending upon wind velocity and other environmental factors, numerical displays of agent concentration in typical units would be impractical and unreliable. Accordingly, the display warns of a low vapor hazard (1 to 3 bars visible), a high vapor hazard (4 to 6 bars visible), or a very high vapor hazard (7 to 8 bars visible).

### **M22 Automatic Chemical Agent Alarm (ACADA)**

The M22 is an automatic agent alarm system capable of detecting and identifying standard blister and nerve agents. The system is man-portable, operates independently after system start-up, and provides an audible and visual alarm. The M22 system also provides communications interface for automatic battlefield warning. The system consists of the M88 detector, as many as five M42 alarm units, a confidence sample, protective caps, square inlet, rain caps, a carrying case, and various power supplies.

The M22 ACADA samples the air for the presence of nerve agent vapors (GA, GB, GD, VX) and blister agent vapors (HD, L), and provides simultaneous detection and warning of these agents. It operates in cold and hot climates (-30°F to +125°F). Tactical operations of the M22 system are basically the same as the M8A1 Automatic Chemical Agent Alarm, except for some improvements over the M8A1. The M88 detectors normally are placed facing into the wind no more than 150 meters outside of the unit perimeter, with no more than 300 meters between detectors. They are connected to the alarm units with WD-1/TT telephone wire; whenever possible, the distance between the detector units and the alarm units should not exceed 400 meters. Improvements over the M8A1 system are as follows:

- Simultaneous detection and warning of nerve and blister agents
- Significantly more sensitive than the M8A1
- Much less response to interference

The following items can interfere with the normal operation of the M22 ACADA and will sound a false alarm:

- CS Tear Gas
- JP8 Fuel
- Brake Fluid
- Aqueous Fire Fighting Foam (AFFF)
- M18 Marking Grenade (Red and Violet)

### **Chemical Agent Alarm: M8A1**

6665-01-105-5623

The M8A1 Automatic Chemical Agent Alarm (ACAA) a remote, continuous air sampling alarm, which samples the air for the presence of NERVE agent vapors (GA, GB, GD, and VX) only. The M8A1 alarm uses 0.01 millicurie of americium-241 ( $\text{Am}^{241}$ ), a source of alpha particles, to ionize airborne agent molecules drawn into the sampling chamber by a pump module. A detector cell analyzes the resulting ion clusters and compares their masses and charges with electronically stored standards to detect the presence of nerve agent vapors. The operator may specify whether the alarm itself is audible, visual, or both.

The system consists of the M43A1 detector, as many as five M42 alarm units, and various power supplies. The detector cell and alarm units are most commonly found in a fixed-site configuration. Normally the M43A1 detectors are placed facing into the wind no more than 150 meters outside the unit perimeter, with no more than 300 meters between detectors, and when possible, no more than 400 meters between the detector cells and the alarm units. WD-1/TT 6145-00-226-8812 telephone cable connects the detector cells and the alarm units. The alarm units are placed throughout the facility. A typical Mobile Army Surgical Hospital (MASH) has three M8A1 ACAAs, and a Combat Support Hospital (CSH) has seven M8A1 ACAAs.

### **Water Testing Kit, Chemical Agents: M272**

6665-01-134-0885

TM 3-6665-319-10

The M272 water test kit was designed and fielded to answer the need for a test to detect water contamination by nerve agent, blister agent, cyanide ("blood" agent), or Lewisite. The kit will operate between 32°F and 125°F. An enclosed instruction card enables the soldier to conduct all the tests required to identify the threat agents. The kit will detect the following chemical agents at the concentrations indicated on the following chart.

<b>Chemical Agent</b>	<b>Symbol(s)</b>	<b>Concentration (mg/l)-*</b>
Cyanide	AC	20.0 as $\text{CN}^-$
Mustard	HD	2.0 --
Lewisite	L	2.0 as $\text{As}^{+++}$
Nerve	G/V	0.02 --

\*Concentration reliably detected by kit tests. Water containing agents in lesser concentrations is permissible for short-term use (up to 7 days) in both cold and warm regions as long as the daily consumption per person does not exceed 5 quarts. Each kit contains enough reagents for tests on 25 separate water samples. The operator can easily conduct the full range of tests in 20 minutes when the temperature is between 50°F and 105°F; at lower temperatures, the water samples and the nerve agent ticket should both be warmed for 10 minutes before beginning testing. Water that is too hot may cause foaming in the detector tubes for Lewisite, mustard, and cyanide; therefore, water at temperatures between 105°F and 125°F should be cooled for at least 5 minutes to reduce its temperature to 105°F or cooler.

## **PATIENT PROTECTIVE EQUIPMENT**

In this section, the following three items that have been fielded will be discussed:

- Patient Protective Wrap
- Decontaminable Litter
- Resuscitation Device Individual Chemical (RDIC)

### **Patient Protective Wrap**

8456-01-079-9875

Army Medical Department (AMEDD) doctrine calls for the treatment of casualties from the integrated battlefield as far forward as possible. Because treatment often mandates removal of the BDO and precludes donning replacement BDOs, a patient protective wrap has been developed. This wrap is sturdy and lightweight, weighing approximately 2.7 kg, and it protects the patient from all known chemical agents for up to six hours. It is not designed for use by more than one patient and must be discarded after use.

One continuous zipper around the outer edge of the top sheet provides easy patient insertion into the wrap, and observation of the patient is possible through an impermeable transparent window at the head of the wrap. Below the window is a small transparent pocket large enough to hold a field medical card or other medical record, and two protected sleeves next to the window permit the passage of IV tubing.

The wrap is designed to be used on a litter but can itself become a field-expedient litter if necessary. Along the sides of the wrap are sleeves through which poles can be inserted. These sleeves have handholds for manual carries when poles are not available. It is recommended that the patient wear the mask while in the wrap, but this is not a requirement. However, before the casualty is put into the wrap, a cardboard insert must first be placed into the wrap to hold the window material away from the patient's face.

Although the protective wrap is permeable to both oxygen and carbon dioxide, the rate at which carbon dioxide is produced by a typical patient exceeds, by a small amount, the rate at which this gas passes through the wrap. Therefore, the patient should not be left in the wrap for longer than the recommended maximum of six hours.

### **Decontaminable Litter**

6530-01-290-9964

Contaminated casualties arriving at a medical treatment location will in most cases require decontamination prior to definitive treatment. This decontamination process will require the use of the limited supplies of equipment organic to the treatment unit. Ideally, equipment in limited supply should be capable of complete decontamination using field-available methods. However, in tests conducted by the U.S. Army Soldier and Biological Chemical Command, canvas litters exposed to liquid blister agents and then decontaminated still desorbed vapors for 72 hours after all surface contaminants were removed.

The decontaminable litter was developed to replace the canvas litters. The new litter is made from a monofilament polypropylene that has high tensile strength and low elasticity. The fabric does not absorb liquid chemical agents and is not degraded by decontaminating solutions. The fabric is flame retardant, highly rip resistant, and treated to withstand exposure to weather and sunlight. The fabric has a honeycomb weave which results in a rough, non-slip surface, and liquids easily pass through the 40% of surface area that is open. The carrying handles retract into the metal pole frame for a closed total length of 83.5 inches (212.1 cm) to allow for loading the litter onto the UH-60 helicopter. The handles have TWO open positions, 90.0 inches (228.1 cm) and 91.6 inches (232.7 cm). The first position is a NATO standard, and the second position was provided to allow increased gripping comfort by litter bearers. The aluminum poles have been designed to provide direct gripping surfaces for litter stanchions. All metal parts have been painted with Chemical Agent Resistant Coating (CARC) paint.

### **Resuscitation Device, Individual Chemical**

6665-01-338-6602

The Resuscitation Device, Individual Chemical (RDIC) is a ventilatory system consisting of a compressible butyl rubber bag, a NATO standard C2 canister filter, a nonbreathing valve, a cricothyroid cannula adapter, and a flexible hose connected to an oropharyngeal mask. The mask is removable from the distal end of the flexible hose for connection of the hose to the cannula adapter. The butyl rubber bag resists the penetration of liquid chemical agent that may be on the chemical protective gloves of operator and is easily decontaminated. The elasticity of the outer cover limits airway pressure to a maximal value of 70 cm H<sub>2</sub>O (70 mbar). The device will deliver up to 600 ml of filtered air per cycle at a rate of 30 cycles per minute.

The RDIC will be fielded one per air ambulance, one per ground ambulance, and one per Chemical Agent Treatment, MES.

## Appendices

### APPENDIX A

Shown on the foldout is a summary of the chemical agents, the effects they cause, and the first-aid therapy.

### APPENDIX B Equipment List

5 ton truck	1 ea	Doubles as transport to MTF
400 gallon water trailer	1 ea	
5 gallon water cans	20 ea	10 for CI solution preparation; 10 for refilling canteens
1 quart or 2 quart canteens	20 ea	For use by decon personnel
Chemical Agent Monitor	2 ea	Authorized by MTO&E 6665-01-199-4153
M8A1 ACAA	1 ea	Authorized by MTO&E 6665-01-105-5623
Decontaminable litters	24 ea	6530-01-290-9964
M9 Chemical Detector Paper	10 rl	6665-01-049-8982
M8 Chemical Detection Paper	1 bx	6665-00-050-8529

M291 SDK	5 bx	4230-01-276-1905
M295 DKIE	2 bx	4230-01-357-8456
Calcium	16 bt	6810-00-255-0471
Hypochlorite	25 lb	6810-00-264-6591
M256A1 Chemical Agent Detection Kit	5 ea	6665-01-016-8399
Field Medical Cards	5 bk	
Super Tropical Bleach (STB)	5 dr	Shuffle pit preparation
Litter Support Stands	12 ea	6530-00-914-3490
Carrier, Litter, Wheeled	4 ea	6530-00-220-7186
7.25" Bandage Scissors <sup>1</sup>	1 cs	6515-00-935-7135
Sponge <sup>2</sup>	2 cs	7920-00-240-2559
"Zip-lock" bags	100 ea	SSSC
35 gallon trash bags	50 ea	Packaging waste from decon site
Field telephones	2 ea	Authorized by MTO&E

TAP aprons	3 ea	Small 8415-00-281-7813
	5 ea	Medium 8415-00-281-7814
	8 ea	Large 8415-00-281-7815
	4 ea	X-Large 8415-00-281-7816
Chemical protective gloves	5 pr	Small 8415-00-033-3517
	10 pr	Medium 8415-00-033-3518
	10 pr	Large 8415-00-033-3519
	3 pr	X-Large 8415-00-033-3520
Chemical protective tactile gloves	5 pr	Small 8415-01-138-2501
	10 pr	Medium 8415-01-138-2502
	10 pr	Large 8415-01-138-2503
	3 pr	X-Large 8415-01-138-2504

Grease pencils	2 bx	SSSC
12 quart steel pail	16 ea	7420-00-773-0975

<sup>1</sup>Removing BDOs, BDUs, hoods, protective boots, and combat boots by cutting will ruin 1 pair of bandage scissors for every two casualties.

<sup>2</sup>Replace sponge when CI solution is replaced. CI solution should be replaced after being used on two casualties.

## APPENDIX C

### **Preparation of Patient Decontamination Solutions (0.5 & 5.0% Hypochlorite)**

Preparation of the 0.5% and 5% hypochlorite solutions will require mixing the solutions in a container that can be closed after completion. By closing the container, the solution will remain at the required strength far longer than if allowed to stand in an open container. The recommended mixing container is a 5-gallon water can. The hypochlorite granules must be completely dissolved in the water. The most effective method for mixing is to agitate the granules as they are poured into the water, and then allow the solution to sit for 20 minutes to ensure the granules dissolve.

#### **0.5% Hypochlorite Solution**

Use 6-ounce bottles of calcium hypochlorite granules found in the Chemical Agent Patient Decon MES, and mix one 6-ounce bottle into 5 gallons of water.

When using a bulk package of calcium hypochlorite, retain one empty 6-ounce bottle from the chemical Agent Patient Decon MES to measure the correct amount of dry calcium hypochlorite granules and mix as described above.

If you must use household bleach (i.e., Clorox or Purex), use the following procedure. The bleach should be packaged in 1-quart bottles or 1-gallon jugs when received from supply. Only 4.5 gallons of water will be used. Mix 2 quarts of bleach into 4.5 gallons of water, and store the solution in a closed container until ready to use.

#### **5.0% Hypochlorite Solution**

Use 6-ounce bottles of calcium hypochlorite granules found in the Chemical Agent Patient Decon MES, and mix 8 of the 6-ounce bottles of calcium hypochlorite into 5 gallons of water.

If using calcium hypochlorite from a bulk package, retain one empty 6-ounce bottle from the Chemical Agent Patient Decon MES to measure the correct amount of dry calcium hypochlorite granules.

If you must use household bleach (i.e., Clorox or Purex), use the bleach straight from the bottle; do not mix in water.

## APPENDIX D

### MEDICAL EQUIPMENT SET CHEMICAL AGENT PATIENT TREATMENT

NOMENCLATURE/NSN	AMOUNT
Atropine Inj. 0.70L/6505-00-926-9083	500 ea
Pralidoxime Chloride/6505-01-125-3248	100 ea
Boric Acid 5%/6505-01-153-3012	36 tu
Sodium Nitrite/6505-01-206-6009	12 pg
Sodium Thiosulfate/6505-01-206-6010	12 pg
Diazepam/6505-01-206-6010	3 pg
Atropine Sulfate/6505-01-332-1281	1 pg
Infusion Set Size: 2/6515-00-089-2791	60 ea
Airway Pharyn LGE/6515-00-300-2900	6 ea
Airway Pharyn SM/6515-00-300-2910	6 ea
Syringe Hypo 10 ml/6515-00-754-0412	.6 pg
Needle Hypo 18 ga/6515-01-754-2834	1.2 bx
Suction Apparatus/6515-01-076-3577	4 ea

<b>NOMENCLATURE/NSN</b>	<b>AMOUNT</b>
Resuscitator Hand/6515-01-338-6602	4 ea
Syringe Hypo 50 ml/6515-01-076-3577	1 pg
Chest No. 4/6545-00-914-3490	3 ea
Gloves Chem/8415-01-138-2502	2 pr
Gloves Chem/8415-01-138-2503	2 pr
Bag Chem Cas/8465-01-079-9875	12 ea

**MEDICAL EQUIPMENT SET  
CHEMICAL AGENT PATIENT DECONTAMINATION**

<b>NOMENCLATURE/NSN</b>	<b>AMOUNT</b>
M291 SDK/4230-01-276-1905	2 bx
Bandage Scissors/6515-00-935-7138	6 ea
Syringe Hypo/6515-01-280-2320	.6 pg
Litter Support/6530-00-660-0034	4 pr
Chest No. 4/6545-00-914-3490	1 ea
Chest No. 6/6545-00-914-3510	1 ea
M9 Chem Agt Paper/6665-01-049-8982	1 ro
Calcium Hypo/6810-00-255-0471	48 bo
12 qt Pail/7240-00-773-0975	10 ea
Sponge Cellulose/7920-00-884-1115	6 ea
Bag Plastic/8105-00-191-3902	2 ro
Plastic Sheet/8135-00-191-3902	2 ro
Work Gloves MED/8415-00-268-8353	25 pr
Work Gloves SM/8415-00-258-8354	25 pr
Black Pencils/7510-00-240-1526	2 dz
TAP Apron SM/8415-00-281-7813	2 ea

<b>NOMENCLATURE/NSN</b>	<b>AMOUNT</b>
TAP Apron MED/8415-00-281-7814	4 ea
TAP Apron LRG/8415-00-281-7815	2 ea
Chem Prot Glove/8415-01-033-3517	2 ea
Chem Prot Glove/8415-01-033-3518	4 ea
Chem Prot Glove/8415-01-033-3519	2 ea
Decon Litter/6530-01-290-9964	4 ea

## APPENDIX E

Shown in the foldout is a casualty receiving area for contaminated casualties. This area must be the receiving area for any medical treatment area that receives contaminated casualties.

## APPENDIX F GLOSSARY OF MEDICAL TERMS

**Acetylcholine.** A chemical released by certain nerves that stimulates a muscle, gland, or another nerve. This is one of a number of neurotransmitters in the body that carry “messages” from nerves to other organs.

**Acetylcholinesterase.** An enzyme (a protein produced in the cells) that stops the action of acetylcholine by destroying it. This action occurs as soon as acetylcholine has produced a muscle contraction or stimulated a gland or nerve. Nerve agents combine with acetylcholinesterase to prevent it from destroying acetylcholine; acetylcholine accumulates in excess and continues to stimulate the muscle, gland, or nerve.

**Alveoli.** Microscopic air sac in the lungs where oxygen and carbon dioxide diffusion takes place through the alveolar walls.

**Anorexia.** Loss of appetite.

**Anoxemia.** Inadequate oxygenation of the blood.

**Anoxia.** Lack of oxygen.

**Antibiotic.** A natural or synthetic substance that inhibits the growth of or destroys microorganisms. Used extensively in the treatment of infectious diseases in plants, animals, and humans.

**Anticholinergic.** An agent or chemical that blocks or impedes the action of acetylcholine, such as the antidote atropine.

**Anticholinesterase.** A substance that blocks the action of cholinesterase (acetylcholinesterase), such as nerve agents.

**Aphonia.** Inability to phonate or produce speech sounds.

**Aplasia.** Failure of production of cellular products from an organ or tissue, such as blood cells from the bone marrow, after a toxic dose of mustard.

**Apnea.** Cessation of breathing.

**Ataxia (ataxic).** A staggering or unsteady gait; inability to walk a straight line.

**Atelectasis.** Collapse of the alveoli of the lungs secondary to mucous plugs, foreign bodies, and secretions. Frequently associated with pneumonia, best treated by vigorous coughing and breathing exercises, as well as Positive Pressure Breathing with PEEP.

**Bradycardia.** A slow heart rate (less than 60 beats per minute).

**Blepharospasm.** A twitching or spasmodic contraction of muscles around the eye; if severe, can lead to closure of the eyes.

**Bronchoconstriction.** Constriction of the bronchial tubes making it difficult to move air in and out of the lungs.

**Bronchopneumonia.** Inflammation of the terminal bronchioles and alveoli, causing edema and consolidation of alveoli.

**Ciliary**. Pertaining to certain structures in the eye, such as the ciliary muscles.

**Conjunctiva**. The delicate membrane that lines the eyelids and covers the exposed surface of the sclera.

**Conjunctival**. Pertaining to conjunctiva.

**Conjunctivitis**. Inflammation of the conjunctiva.

**Corium**. The deeper layer of the skin under the epidermis. It contains the hair follicles, sweat glands, and sebaceous glands.

**Cornea, corneal**. The clear, transparent, anterior portion of the eye comprising about one-sixth of its surface through which light passes to transmit images to the retina. It is continuous at its periphery with the sclera and composed of five layers.

**Cyanosis**. Slightly bluish, grayish, slate-like, or dark purple discoloration of the skin due to oxygen in the blood.

**Cyclitis**. Inflammation of the ciliary body of the eye.

**Dermatitis**. An inflammation or infection of the skin.

**Dyspnea**. Labored breathing resulting from an increased need for oxygen or inadequate air exchange in the lungs.

**Edema**. Swelling of the tissues because of fluid.

**Emphysema**. Process of trapping air in the alveoli, associated with loss of elasticity of the lung tissues and resulting in inability to completely exhale.

**Epithelium**. The outer layer of the skin.

**Erythema**. Red area of skin caused by heat or cold injury, trauma, or inflammation. May be localized or generalized.

**Fasciculation**. Localized contraction of muscle fibers, usually visible through the skin.

**Fibrosis**. Scar tissue; replacement by fibrous tissue.

**Flaccid paralysis**. Loss of muscle tone and capability to function; limp. Nerve agents cause this condition.

**GI**. Gastrointestinal; gut.

**Granulocytopenia**. Decrease in white cells of the granulocyte series in the bloodstream.

**Hematopoietic**. Pertaining to production and development of blood cells.

**Hemoconcentration**. A relative increase in the number of red blood cells, usually resulting from a decrease in the volume of plasma.

**Hyperemia**. Redness of the skin.

**Hypertension**. High blood pressure.

**Hypotension**. Low blood pressure; if blood pressure is too low, shock and death may occur.

**Hypovolemic shock**. Insufficient blood volume to maintain adequate tissue oxygenation and aerobic metabolism.

**Hypoxemia (hypoxia)**. Insufficient oxygen in the circulatory system to adequately supply tissue cells. May be caused by lack of oxygen, inadequate hemoglobin to carry oxygen, or interference with transfer of oxygen to the cells.

**Iritis**. Inflammation of the iris with accompanying pain, photophobia, lacrimation, and diminution with transfer of oxygen to the cells.

**Leukocytosis**. Above normal increase of white blood cells.

**Leukopenia**. Less than normal number of white blood cells.

**Lymphadenitis.** Inflammation of lymph nodes, usually caused by a focus of infection distal to the node.

**Miosis.** Small, “pinpoint” pupils.

**Mydriasis.** Large or dilated pupils.

**Necrosis.** Death of tissue.

**Necrotic.** Pertaining to necrosis, end result of necrosis, dead.

**Pruritis.** Itching.

**Pulmonary edema.** Fluid in the lungs; associated with an outpouring of fluids from the capillaries into the pulmonary spaces (air sacs or alveoli) producing severe shortness of breath. In later stages, produces expectoration of frothy, pink, serous fluid and cyanosis.

**Rhinitis.** Inflammation of nasal mucous.

**Rhinorrhea.** Thin watery discharge from the nose; runny nose.

**Tachycardia.** A rapid heart rate (over 90 beats per minute).

**Thrombocytopenia.** An absolute decrease in the circulating platelets in the blood.

**Urticant.** Something that causes itching or stinging and a raised area on the skin (wheal).

**Vacuolation.** Formation of a space.

**Vascularization.** Development of new blood vessels in a structure.

**Vasoconstriction.** Diminution of interior size of a blood vessel with resultant decrease in blood flow.

**Vertigo.** Dizziness where space seems to move around.

**Vesicant.** Something that causes a vesicle (blister). Many things will do this, such as poison ivy and certain animal stings. Some chemical agents (mustard and Lewisite) are vesicants.

**Vesication.** Blistering.

**Zoonosis.** A disease of animals that may be transmitted to man under natural conditions.

**Zoonotic.** Transmissible from animals to man under natural conditions; pertaining to or constituting a zoonosis.

## APPENDIX G

### Glossary of Military Terms

**ACAA:** Automatic Chemical Agent Alarm  
**AMEDD:** Army Medical Department  
**BDO:** Battle Dress Overgarment  
**BDU:** Battle Dress Uniform  
**CAM:** Chemical Agent Monitor  
**CANA:** Convulsive Antidote, Nerve Agent  
**CARC:** Chemical Agent Resistant Coating  
**C/B:** Chemical/Biological  
**CDC:** Chemical Decontamination Center  
**CBPS:** Chemical and Biological Protective Shelter  
**CPS:** Chemical Protective Shelter  
**DBDO:** Desert Battle Dress Overgarment  
**DTD:** Detailed Troop Decontamination  
**ECP:** Entry Control Point  
**FMC:** Field Medical Card  
**GREGG:** Graves Registration  
**HTH:** High Test Hypochlorite  
**KPH:** Kilometers Per Hour  
**LBE:** Load Bearing Equipment  
**LCL:** Liquid Control Line  
**MES:** Medical Equipment Set  
**MOPP:** Mission Oriented Protective Posture  
**MTF:** Medical Treatment Facility  
**MTO&E:** Modified Table of Organization and Equipment  
**NAAK:** Nerve Agent Antidote Kit  
**NATO:** North Atlantic Treaty Organization  
**NCO:** Noncommissioned Officer  
**NCOIC:** Noncommissioned Officer-in-Charge  
**OIC:** Officer-in-Charge  
**SDK:** Skin Decontamination Kit  
**TAP:** Toxicological Agent Protective (e.g., TAP Apron)  
**TC:** Training Circular  
**VCL:** Vapor Control Line

## APPENDIX H

Shown in the foldout is the set-up for the Personnel Decontamination Station.

## INDEX

2-PAMCI · 21, 22, 25

---

### A

AC · 43, 44, 46, 47, 112, 172, 174, 179  
acetylcholine · 7, 8, 10, 74, 196  
aerosol · 4, 9, 60, 61, 65, 77  
airway · 10, 21, 24, 80, 92, 130, 183  
airways · 3, 10, 19, 32, 47, 51  
alveoli · 51, 52, 197, 198, 200  
antidotes · 16, 80  
apnea · 10  
atropine · 3, 19, 20, 21, 196  
autoinjector · 17, 21, 22, 23, 24

---

### B

BAS · 20, 47, 91  
BDO · 62, 89, 94, 110, 112, 114, 130, 134, 135,  
138, 139, 143, 145, 146, 147, 148, 159, 160,  
161, 168, 170, 180, 202  
BDU · 84, 137, 138, 144, 148, 202  
blister · 25, 28, 29, 31, 34, 37, 38, 39, 40, 74,  
170, 174, 175, 176, 178, 182, 201  
blister agent · 29, 35  
blister agents · 28, 35, 175  
blood · 11, 22, 44, 51, 52, 92, 178, 196, 197,  
198, 199, 200, 201  
breathing · 3, 10, 14, 15, 19, 20, 21, 23, 46, 54,  
76, 90, 92, 197, 198  
buddy-aid · 13, 16, 17, 23, 33, 34, 47, 79, 82, 88  
BVO · 136, 147, 162, 163

---

### C

CAM · 3, 31, 32, 82, 104, 119, 127, 140, 143,  
148, 149, 151, 152, 174, 175, 202  
casualties · 2, 79  
casualty · 2, 5, 88, 104, 105, 130, 143  
central nervous system · 7  
cessation · 10, 47, 197  
cholinesterase · 197  
CK · 43, 44, 45, 46, 47, 112, 172, 174, 3  
CNS · 12, 90  
combat lifesaver · 8, 11, 12, 13, 16, 19, 20, 21,  
23, 29, 37, 38, 40, 41, 47, 48, 79, 80, 81, 85,  
86, 87, 90, 110  
convulsions · 3, 5, 22, 1

Ct · 4, 5  
CX · 112, 172, 174  
cyanogen chloride · 44, 174

---

### D

decon · 64, 82, 83, 84, 96, 122, 124, 126, 127,  
141, 150, 152, 167, 185, 186  
decontamination · 4, 5, 3, 59, 64, 97, 99, 100,  
104, 105, 107, 119, 124, 127, 128, 130, 139,  
140, 143, 150, 152, 154, 165, 167, 189, 202,  
203, 204  
diazepam · 3, 15, 16, 17, 20, 21, 22, 23, 24, 84,  
129  
distilled mustard · 172  
DKIE · 167, 168, 186

---

### E

erythema · 32, 33, 39, 93  
eye · 9, 20, 33, 38, 91, 133, 156, 157, 197, 198  
eyes · 4, 9, 20, 31, 32, 34, 39, 47, 52, 77, 84,  
140, 155, 158, 166, 197

---

### F

fasciculations · 12

---

### G

G · 112, 169, 172, 174, 175, 179, 202  
GA · 3, 4, 6, 66, 176, 177, 1  
gastrointestinal tract · 8  
GB · 3, 4, 6, 25, 112, 176, 177  
GD · 3, 4, 6, 25, 26, 112, 113, 176, 177  
GF · 3, 4, 6, 25  
gloves · 62, 89, 91, 125, 127, 131, 135, 136,  
137, 138, 140, 143, 146, 163, 164, 167, 170,  
183, 187

---

### H

H · 27, 28, 29, 31, 32, 113, 118, 169, 172, 175,  
204  
HD · 27, 28, 29, 31, 32, 113, 172, 174, 176, 179  
heart · 11, 77, 197, 200  
HL · 28, 29, 31, 32, 33

HN · 172  
hood · 89, 90, 101, 114, 131, 132, 133, 138,  
140, 143, 144, 145, 155, 158, 167, 169  
hydrogen cyanide · 44, 174

---

## I

IC<sub>50</sub> · 5, 6

---

## L

Lewisite · 28, 29, 33, 172, 178, 179, 201  
liquid · 3, 15, 50, 202  
litter · 80, 82, 94, 96, 103, 104, 105, 122, 124,  
125, 127, 129, 130, 131, 133, 135, 136, 138,  
139, 141, 143, 147, 152, 181, 182

---

## M

M17A2 · 156  
M24 · 157  
M256A1 · 3, 31, 44, 83, 118, 119, 121, 168, 171,  
173, 186  
M258A1 · 139  
M272 · 168, 178  
M291 · 3, 34, 35, 37, 64, 125, 126, 131, 132,  
133, 139, 143, 149, 165, 166, 168, 186, 193  
M295 · 3, 37, 132, 133, 143, 149, 165, 167, 168,  
186  
M40 · 62, 154, 155, 156  
M8 · 3, 31, 81, 89, 101, 113, 118, 119, 121, 125,  
127, 131, 140, 148, 149, 155, 168, 169, 171,  
172, 185  
M8A1 · 3, 82, 118, 119, 120, 168, 176, 177, 178,  
185  
M9 · 3, 31, 34, 81, 84, 89, 101, 112, 114, 119,  
140, 168, 170, 185, 193  
MARK I · 3, 14, 15, 16, 17, 20, 22, 26, 84, 126,  
129, 131  
mask · 9, 33, 34, 47, 54, 61, 81, 89, 114, 129,  
130, 131, 133, 144, 145, 153, 156, 157, 158,  
167, 169, 170, 171, 181, 183  
MOPP · 18, 33, 37, 62, 84, 85, 101, 106, 107,  
118, 120, 121, 128, 130, 150, 153, 160, 161,  
202  
mouth · 8, 9, 14  
MTF · 38, 39, 41, 80, 83, 85, 99, 100, 102, 185,  
202  
muscles · 7, 12  
mustard · 27

---

## N

NAAK · 202  
NAPP · 84, 118  
nausea · 3, 11, 70  
nerve agents · 4, 5, 112, 113, 172  
nitrogen mustard · 172  
nose · 3, 9, 14, 21, 31, 36, 45, 47, 52, 64, 157,  
200  
NOx · 49

---

## O

overboots · 136, 137, 141, 144, 147  
oxides of nitrogen · 49

---

## P

paralysis · 3, 12, 14, 15, 74, 75, 78, 199  
PFIB · 49  
phosgene oxime · 174  
photophobia · 200  
pralidoxime · 3  
pretreatment · 24, 25, 26, 89  
protective wrap · 125, 180  
pyridostigmine · 24, 25, 26, 89

---

## R

RDIC · 24, 127, 151, 180, 183  
respiration · 12, 14, 47  
respirations · 10  
respiratory · 3, 4, 20, 22, 31, 32, 41, 61, 62, 64,  
65, 67, 70, 71, 74, 76, 92, 155, 157  
respiratory tract · 8  
resuscitation · 24, 127

---

## S

Sarin · 4  
SDK · 34, 35, 64, 125, 126, 131, 132, 139, 143,  
168, 186, 193, 203  
secretions · 3, 10, 19, 20, 21, 39, 197  
self-aid · 14, 15, 34, 37  
signs · 3  
skin · 3, 4, 5, 9, 10, 11, 12, 18, 19, 28, 29, 30,  
31, 32, 33, 34, 37, 39, 50, 64, 65, 67, 71, 73,  
74, 77, 82, 84, 89, 90, 91, 104, 105, 127, 131,  
138, 139, 140, 147, 149, 161, 165, 166, 170,  
198, 199, 200  
soman · 4  
suction · 3, 80

sweat · 8, 11  
symptoms · 3, 19, 20, 59, 66, 67, 69, 70, 71, 72,  
75, 76, 77, 78, 84

---

## ***T***

Tabun · 4  
Teflon · 49, 53  
triage · 38, 83, 85, 86, 87, 88, 90, 97, 103 113,  
122, 125, 128, 130, 139, 144, 152

---

## ***U***

unconscious · 20

---

## ***V***

vapor · 3, 6, 14, 36, 46, 203  
ventilation · 3, 21, 24, 54, 80, 157  
vomiting · 3, 11, 15, 46, 68, 69, 74, 75, 77, 78,  
VX · 3, 4, 5, 6, 25, 113, 174, 175, 176, 177

---

## ***W***

weakness · 3, 12, 13, 14, 15, 72, 78

# PULMONARY AGENTS

CG

## SUMMARY

**Signs and Symptoms:** eye and airway irritation, dyspnea, chest tightness, and **delayed** pulmonary edema.

**Detection:** **odor** of newly mown hay or freshly cut grass or corn. Neither the M256A1 detector kit nor chemical-agent detector paper (M8 paper, M9 paper) is designed to identify phosgene, but the MINICAMS, Monitox Plus, Draeger tubes, Individual Chemical Agent Detector (ICAD), M18A2, M90, and M93A1 Fox will detect small concentrations of this gas.

**Decontamination:** **vapor** - fresh air; **liquid** - copious water irrigation.

**Management:** termination of exposure, ABCs of resuscitation, enforced rest and observation, oxygen with or without positive airway pressure for signs of respiratory distress, other supportive therapy as needed.

## SUMMARY

**Signs and Symptoms:** few. After exposure to high Ct, seizures, respiratory and cardiac arrest.

**Detection:** The **M256A1 detector ticket** detects hydrogen cyanide (AC) as vapor or gas in the air, and the M272 kit detects cyanide in water. The ICAD, M18A2, and M90 detectors also detect AC. The CAM, M8A1 automatic chemical agent alarm (ACAA), and M8 and M9 paper do not detect cyanide.

**Decontamination:** Skin decontamination is usually not necessary because the agents are highly volatile. Wet, contaminated clothing should be removed and the underlying skin decontaminated with water or other standard decontaminants.

**Management:** **Antidote:** intravenous (IV) sodium nitrite and sodium thiosulfate. **Supportive:** oxygen, correct acidosis.

**CYANIDE** AC, CK

# MUSTARD

HD, H

## SUMMARY

**Signs and Symptoms:** asymptomatic latent period (hours). Erythema and blisters on the **skin**; irritation, conjunctivitis, corneal opacity, and damage in the **eyes**; mild upper respiratory signs to marked **airway** damage; also gastrointestinal (GI) effects and bone marrow stem cell suppression.

**Detection:** M256A1, M272 water testing kit, MINICAMS, the ICAD, M18A2, M21 remote sensing alarm, M90, M93A1 Fox, Bubbler, CAM, and DAAMS (but **NOT** the M8A1 automatic chemical agent alarm), M8 paper, or M9 paper.

**Decontamination:** 0.5% hypochlorite, M291 kit, and water in large amounts.

**Management:** Decontamination immediately after exposure is the only way to prevent damage. Supportive care of patients - there is no specific therapy.

# LEWISITE

L

## SUMMARY

**Signs and Symptoms:** Lewisite causes immediate pain or irritation of skin and mucous membranes. Erythema and blisters on the skin and eye and airway damage similar to those seen after mustard exposures develop later.

**Detection:** M256A1, M272 water testing kit, MINICAMS, the ICAD, M18A2, M21 remote sensing alarm, M90, M93A1 Fox, Bubbler, CAM, and DAAMS (but **NOT** the M8A1 automatic chemical agent alarm), M8 paper, or M9 paper.

**Decontamination:** M291, 0.5% hypochlorite, water in large amounts.

**Management:** immediate decontamination; symptomatic management of lesions the same as for mustard lesions; a specific antidote (BAL) will decrease systemic effects.

## PHOSGENE OXIME CX

### SUMMARY

**Signs and Symptoms:** immediate burning and irritation followed by wheal-like skin lesions and eye and airway damage.

**Detection:** M256A1, M18A2, M90, and M93 Fox (but **NOT** the M272 water testing kit), MINICAMS, the ICAD, M21 remote sensing alarm, Bubbler, CAM, DAAMS, the M8A1 automatic chemical agent alarm, M8 paper, or M9 paper.

**Decontamination:** water in large amounts, 0.5% hypochlorite, M291.

**Management:** immediate decontamination, symptomatic management of lesions.

## NERVE AGENTS GA, GB, GD, GF, VX

### SUMMARY

**Signs and Symptoms:**

**Vapor:**

**Small exposure** -- miosis, rhinorrhea, mild difficulty breathing.

**Large exposure** -- sudden loss of consciousness, convulsions, apnea, flaccid paralysis, copious secretions, miosis.

**Liquid on skin:**

**Small to moderate exposure** -- localized sweating, nausea, vomiting, feeling of weakness.

**Large exposure** -- sudden loss of consciousness, convulsions, apnea, flaccid paralysis, copious secretions.

**Detection:** M256A1, CAM, M8 paper, M9 paper, M8A1 and M8 alarm systems.

**Decontamination:** M291, M258A1, hypochlorite, large amounts of water.

**Immediate management:** administration of MARK I Kits (atropine and pralidoxime chloride); diazepam in addition if casualty is severe; ventilation and suction of airways for respiratory distress.

## INCAPACITATING AGENTS

### BZ, Agent 15

#### SUMMARY

**Signs and Symptoms:** mydriasis; dry mouth; dry skin; increased DTRs; decreased level of concentration; disturbance in perception and interpretation (illusions and/or hallucinations); denial of illness; short attention span; impaired memory.

**Detection:** No field detector is available.

**Decontamination:** Gentle, but thorough washing of skin and hair with water or soap and water is required. Bleach is not necessary. Remove clothing.

**Management:** **Antidote:** physostigmine.

**Supportive:** monitoring of vital signs, especially core temperature.

## RIOT-CONTROL AGENTS

### CS, CN

#### SUMMARY

**Signs and Symptoms:** burning and pain on exposed mucous membranes and skin, eye pain and tearing, burning in the nostrils, respiratory discomfort, and tingling of the exposed skin.

**Detection:** no detector.

**Decontamination:** **Eyes:** thoroughly flush with water, saline, or similar substance.

**Skin:** flush with copious amounts of water, alkaline soap and water, or a mildly alkaline solution (sodium bicarbonate or sodium carbonate). Generally, decontamination is not needed if the wind is brisk. Hypochlorite exacerbates the skin lesion and should not be used.

**Immediate management:** Usually none is necessary; effects are self-limiting.